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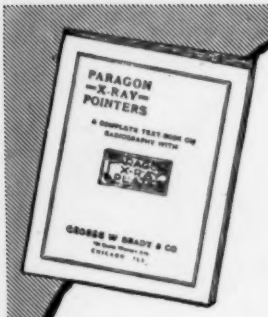

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THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, James T. Case, M.D., Battle Creek, Mich.

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DIAGNOSTIC POINTS IN SUPPURATIVE DISEASES OF THE RIBS AND STERNUM

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IT is not uncommon to meet with cases of suppurative diseases of the rib which have been repeatedly operated without any beneficial result, although the operations had been performed by competent surgeons. The causes of failure are not always apparent. Having had an exceptional opportunity to treat many such cases during the past ten years, I could study the causes of failure of treatment and have reported recently, through the *Illinois Medical Journal*, the results of my observations.

The most frequent cause of failure was found to be the fact that during the operation one or more diseased ribs were overlooked. This was not always the fault of the surgeon, because on exposure the rib very often appears perfectly normal on its surface, the disease being confined to the cancellous channel of the rib or to its under surface. To illustrate this condition, I exhibit roentgenogram Fig. 1.

This roentgenogram illustrates a tuberculosis of the rib in a young man in whom some four years previously I had searched for the focus of the disease in the rib. He had a sinus about one inch beneath the left nipple. The probe could not reveal the direction of the sinus from this point. It penetrated only about one and a half inches, where it was arrested. I exposed the rib over this area and found only a small opening on its surface, otherwise

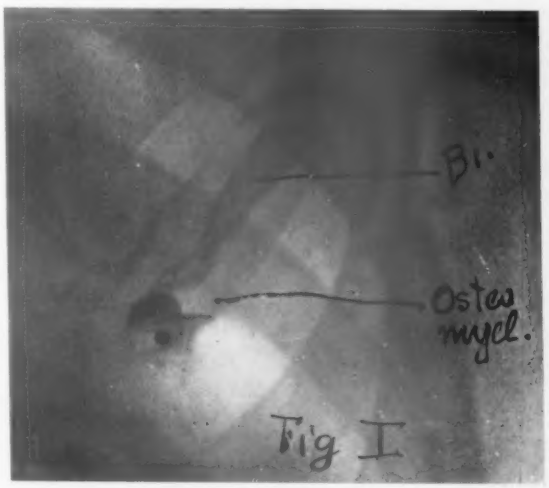

FIG. 1. SINUS OF RIB INJECTED WITH BISMUTH PASTE, SHOWING THE PASTE CONFINED TO THE INTERIOR OF THE RIB.

FIG. 2. TUBERCULOSIS OF THE STERNUM AND RIBS, SHOWING MULTIPLE SINUSES HEALED BY INJECTIONS.

the rib appeared perfectly normal. The sinus led into the interior of the rib, without affecting its upper surface. Thus I was not able to tell the direction of the sinus. I resected part of the rib and curetted as far as I could reach with the curet, but the suppurating sinus persisted. Some months later, the discharge not having ceased, I injected the sinus with bismuth paste, and the roentgenogram, as seen in Fig. 1, was obtained. The study of this roentgenogram taught me that the disease existed within the rib, and that the surface of the rib was perfectly normal. The stereoscope, too, illustrated that the bismuth paste was within the channel of the bone.

A second operation was then performed and the diseased rib resected, the bismuth injection guiding us in regard to its extent. The bed from which the rib was removed was left open, without suturing, for granulation. Suppuration stopped within a week.

It is, of course, essential to make the stereoscopic roentgenograms in order to tell whether the disease is underneath or in the center of the bone, and this was done in every one of the fifteen cases I observed.

The procedure I employed in diagnosis was as follows: Nearly every one of these cases had one or more sinuses discharging pus, some as many as ten. These sinuses were first injected with bismuth paste and stereoscopic roentgenograms taken. These clearly outlined and traced the sinuses into the diseased bone cavities. In some instances they led to three or four ribs and the sternum; at other times, all the sinuses joined and penetrated only one rib, thus indicating the origin of the disease. At times the injection was sufficient to cure the disease, three out of the fifteen not

FIG. 3. STEREOSCOPIC ROENTGENOGRAM SHOWING INJECTED SINUSES.

requiring any surgical interference whatever after the injections, but the remainder required very extensive operations consisting in the elimination of every vestige of the disease, no matter how far it extended. The operative technic was very much facilitated, because the operation could be performed according to a definite plan disclosed by the roentgenograms.

Three methods of examination are most commonly employed by surgeons at the present time: First, the single roentgenogram; second, the probe; third, an exploration.

The shortcomings to these methods are the following:

First: The single roentgenogram is not a reliable aid, because it does not give us definite information as to the depth of the sinus or the seat of the disease. The disease may exist in the interior of the rib, and the bone on its surface may appear absolutely normal. Therefore, I would advocate in every case the use of stereoscopic roentgenograms.

Second: I wish to enter a protest against the use of the probe as a reliable diagnostic aid for this class of cases and also against the indiscriminate curettage of these cases. The probe may be a very useful instrument in some instances, but in tracing sinuses in the ribs its use borders on the ridiculous. One need only glance at one of these roentgenograms to see how useless it would be

FIG. 4. LOCALIZERS FOR LOCALIZING DISEASED RIB.

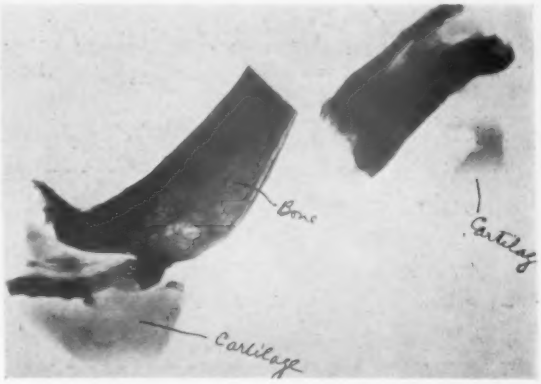

FIG. 5. REMOVED SPECIMEN OF DISEASED RIB SHOWING THE CORRECT DIAGNOSIS OF THE ROENTGENOGRAM.

to penetrate with a probe into the depth of these tortuous channels. Relying entirely upon the probe one might be misled and perform a useless operation.

Third: Exploration without definite knowledge of the extent of the disease is a very difficult matter. The ribs may appear normal on their outer surface while the disease is within, leading the surgeon to overlook the diseased rib. This actually happened in 33 per cent of the cases I have treated.

It is absolutely essential to have the sinuses injected and stereoscopic roentgenograms taken before an exploration is decided upon.

The blind method of curetting these sinuses by introducing the curet through the soft tissues and scraping in all directions without ocular inspection of the cavity is another fallacy. This procedure seems to me most inadequate and uncertain, mere guesswork as to whether one has reached all diseased areas or not. I have convinced myself by exposing and inspecting these cavities after curetting that often I had curetted in the direction of healthy tissues and left most of the diseased area untouched.

It is not always necessary to operate. The injection itself at times will produce a cure. I will introduce one case. A negro, whose sternum and the first and second ribs were diseased, had numerous sinuses suppurating around the neck and

chest for many years, Fig. 2. A curettage of these sinuses was performed a great many times, without any benefit. The injection of the sinuses, Fig. 3, revealed the foci of infection and any attempt to cure this condition without an operation did not look very promising. Nevertheless, the sinuses closed after the injection without any operative treatment.

In order to facilitate the resection of the diseased ribs, I have placed metal pins (the best are victrola pins) along the lower costal margin, as illustrated in Fig. 4. This gives a reliable guide for the localization of the diseased rib.

Conclusion: The radical cure of disease of the ribs depends upon a correct diagnosis; and the stereoscopic roentgenogram, after the injection of the sinuses, is the most reliable aid.

BONE CHANGES IN LEPROSY

BY JAMES A. HONEIJ, M.D.

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THERE are, in general, two types of leprosy, the nerve and the nodular, but there may be a mixed type, combining the main features of both. Usually the nerve type gives rise to atrophic changes and the nodular type to hypertrophic changes. Reasons for selective infection are not understood.

Bone changes follow more or less these two main types: in the nerve type there is interference in function and nutrition, and therefore atrophic bone changes are to be expected, while in the nodular type, inflammation, infiltration and general tissue reaction, due to the widespread dissemination of the infecting organism, will directly or indirectly give rise to changes in the bones other than an atrophy. The change most commonly seen is a halisteresis, either regular and general or confined and irregular. Other important reactions, especially inflammatory, are for the present of secondary consideration.

This investigation into the early bone changes in leprosy was undertaken to determine whether the recognized causes, i.e. nerve affection with atrophy and rarefaction and inflammatory disturbances, directly due to the acid-fast bacilli, are sufficient explanation for the bone changes seen in my cases and now presented here, and whether a more definite idea of the bone changes were not possible.

Leloir, one of the earliest investigators to observe the bone changes, called attention to the fact, in 1886, that a mutilating bone lesion did not always follow ulceration, but was a real phenomenon of absorption, that the bones were diminished in size and that often the phalanges and metacarpals were no thicker than pencils, and even thinner. He also described a true leprous osteomalacia in which, due to the absorption of calcareous elements, the finger could be bent almost at will, adding that these cases did not have a regular course and often affected only one phalanx.

Sawtschenko (1889) observed the node-like changes in the spongiosa and cortical osteoporosis, but found no changes in the periosteum without finding ulcerative changes in the skin. When ulceration of the skin occurred, the periosteum showed more or less inflammation. It is interesting to note that Sawtschenko describes the node changes in the bone as similar to those in the skin, with bacilli in all and different cells. He makes a definite distinction between the bone infiltration and degenerative and resorptive processes and the inflammatory periostitis with bone changes which is due to outside infection.

Baelz (1897) states that the phalanges of the hands and feet are not lost by ulcerative processes unless there is also resorption of tissue and lime salts. He believes, however,

that these destructive processes of the phalanges do not occur simultaneously in all the phalangeal bones but in sequence, one phalanx after another. He also mentions articular pseudo-arthrosis in which the phalangeal joints are more closely approximated.

Kalindero (1897) deals with the bone changes in "lepra mutilans" where an extensive atrophy, affecting the last and also the last but one phalanx, occurs with frequent loss of these bones and even spontaneous fractures due to the great thinning. He believes that the changes in the nerves affect the nutrition of the bones, producing a true osteomalacia due to resorption of the calcium salts; as a consequence, the bones atrophy and fracture where resistance is least. Kalindero's claim to be the first to point out the relationship between the affected nerves and resorption of bone salts is apparently justified. He believes that in nerve leprosy the bone marrow shows no lesions.

Miura (1898) made roentgenograms of museum specimens of hands and feet of two "lepra mutilans" cases, from which he concluded that the necrotic process—that is, changes in relatively normal bone by an ulcerative process—is a wholly different process from that of atrophy; he sees no similarity to that of osteomalacia or rhachitic osteoporotic processes and does not think that bacilli or toxins are the cause of these local changes. He believes also that resorption occurs from the periphery of the bone, as the outer surface of bone is rough and uneven. According to this author there is a regressive metamorphosis of bone and connective tissue, brought about by nerve disturbances and chronic periostitis.

De la Camp (1900) found roentgenological changes in the periosteum of the tibia and phalanges in a case of nodular leprosy. The bones were structureless and the periosteum much thickened. He points out that the thinning of the epiphyses is due to a fundamental tissue resorption through progressive atrophy especially seen in "lepra mutilans." The case presented numerous ulcers on the tibial surface of the leg, infiltration of the skin and leproma on hands and legs, and marked spindle-form thickening of the ulnar nerve. He states that the changes are those of chronic periostitis and by my inference due to the leprosy bacillus in the periosteum and bone marrow.

Hansen and Looft (1894) describe an osteomyelitic condition, an agglomeration of leprous tissue in the bone marrow and in the corticalis associated with necrosis, caries and a process of absorption, commencing at the periphery, and gradually changing the bone into connective tissue.

Scheube (1903) speaks of a simple absorption of the tissues in the pure trophic type, but says that mutilations may occur by a process having its origin in the bones, the phalanges becoming necrotic and being cast off through suppuration.

Hallopeau and Lebret (1903) communicated a case of cranial periostitis and exostosis. The patient was in an advanced stage and presented numerous ulcerated nodules. Of the three areas in the skull, one was ulcerated. The bacillus was present in the histological preparations.

Deycke (1905) comes to no definite conclusion as to the cause of the bone changes occurring in nerve leprosy. He states, however, that the bone resorption is greater than in the nodular cases and suggests that the following factors may be the cause of the bone changes: (1) The loss of lime salts; (2) bone disturbances due to suppurative wasting; (3) bone changes caused by circulatory disturbances; (4) leprous bone disturbances caused by a functional paralysis. According to his conception, the next step would seem to be to demonstrate the process of decalcification by an acid condition whereby the neutralization of the acid principle would be released through disturbed innervation. "If," he says, "the regulation apparatus is disturbed, bone changes must result." In his opinion there never is a callus formed in fractures, and joint contractures do not give rise to bone ankylosis.

Deycke (1906) states that a definite principle separates the two forms of the disease. He points out characteristic bone changes in nodular leprosy, such as the cavity-like appearances, distinctly demarcated from the surrounding bone tissue, productive appearance of periosteum, small bone lepromas and the less diffuse and extensive lime resorption. He concludes that nerve leprosy causes secondary passive lime resorption in the bones, but the true nodular leprosy form leads to primary active lesions of the bones occasioned by specific cell growth.

Black (1906) says that necrosis of bones in the advanced cases is purely due to the nutritive nervous supply being cut off.

Abraham (1907) thinks that destruction of the carpal and metacarpal bones is rare. The affected bones either become necrosed or interstitial absorption of bone takes place; the finger or toe becomes shortened, while the remains of the phalanges ultimately become ankylosed.

Hirschberg and Biehler (1909) distinguish between plastic-inflammatory (hypertrophic) and atrophic degenerative neuroses, as underlying the bone changes of leprosy. In nodular leprosy the bone changes do not run parallel with the severity of the disease as they do in nerve forms of leprosy. The authors claim that the most marked bone change in the nodular form is a periostitis, but also include ostitis, leproma and osteomyelitic processes. These changes are directly related, the authors believe, to the bacilli, whereas the changes in the nerve form are entirely due to trophic-neurotic disturbances. In nerve leprosy it is a degenerative process and in the nodular form it is bacilli plus nerve changes that produce the bone changes. The toes are earlier affected than the hands; other bones may also be affected. In their experience, numerous types of bone changes occur: those of nerve leprosy are similar to many other diseases, and in the nodular form, certain bones such as the tibia are affected with a bone periostitis as in lues.

MacLeod (1909) states that bacilli are absent from the bones and joints, that nerve endings are first attacked, followed by an ascending neuritis. He also declares that the changes in the peripheral nervous system are responsible for the trophic disturbances associated with nerve leprosy.

Sawtschenko (1909) describes a spongioso-fungoid node formation, an osteoporosis and no periostitic process. The bone marrow is first affected, directly due to bacillary action, and next the bone substance. Bone resorption arises through nutritive disturbances and direct bacillary action on the cells.

Harbitz (1910) confines himself to the discussion of the atrophies in leprosy which principally affect distal bones, phalanges, metacarpals and metatarsals. They involve the shaft either in its entirety or concentrically, causing the bone to become thin, porous and brittle and tapering "awl-like," while the distal heads of metacarpi and metatarsi usually disappear. This process may proceed to such a degree that certain bones of the hands and feet finally entirely disappear by absorption. These changes are not due to external inflammation, atrophy by disuse, leprous osteomyelitis, periostitis, or in general by leprous inflammation, but are really of neurotrophic origin, a leprous interstitial neuritis. It is not, he says, a definite form of the disease but associated with advanced leprous neuritis. The nerves suffer from a chronic inflammation, and this will express itself in loss or alteration of the influence normally exerted by the nervous system on nutrition. He gives credit to H. Heiberg, who in 1886 first called attention to atrophies of bones in leprosy.

Herrick and Earhart (1911), point out that pathological changes in bones occur in three ways: *a*, the true trophic disturbance due to altered absorption of bone; *b*, an osteomyelitis or periostitis caused by lepra bacilli; and *c*, a neurosis or inflammation of either of the above, arising from secondary involvement by pyogenic organisms. These processes occur mainly in the

fingers and toes. The description of the earliest trophic changes seen coincides with the description of Harbitz, excepting that the trophoneurotic cases are divided into a progressive distal atrophy and a concentric atrophy. The former occurs most often in mixed cases and constitutes a rapid method of mutilation, and the latter shows a general simultaneous shrinking and absorption of the distal portions and shaft of the phalanges. In addition, Herrick and Earhart call attention to the fact that interphalangeal spaces disappear and the joints become partially, or totally, ankylosed.

Dyer and Hopkins (1911) state that "the mutilation in the anesthetic or nerve type is almost confined to the hands and feet, usually being limited to a loss of the fingers and toes, and is due to trophic changes caused by nerve destruction. The atrophy may be manifested by the "claw-hand," in which the flexor tendons and muscles shrink more than the extensor, drawing the fingers up and preventing extension, or it may affect the bones, causing either necrosis or a gradual degeneration and absorption."

Lenoble and Baron (1911) presenting a case of nerve leprosy, conclude that the factor responsible for the nerve lesions is likewise the cause of bony suppuration.

Neisser (1896) states that "lepra mutilans" must not be considered as due to trophic changes alone but also as the result of mechanical, traumatic lesions of the anesthetic and analgesic nodes.

Jadassohn (1913) believes that inflammatory hypertrophic processes, especially in nodular leprosy, precede the atrophic, necrotic and degenerative changes as distinguished from atrophy as a result of nerve affection. The trophic changes are roentgenologically demonstrable as a thinning or rarefaction of the bone. The bones are necrotic without specific changes.

Miller, presenting a case in 1913 with leprotic changes in the bones of the feet and no history of ulceration, concludes that the earliest sign of leprosy may be alterations in bones.

Dyer (1913) is apparently under the impression that necrosis of phalanges and atrophy occur in the nerve type of leprosy alone.

Colombier (1914) calls attention to the bone changes in a case of leprosy, as demonstrated by roentgenograms, consisting of a loss of substance in the extremity of the phalanges of the feet.

In the "Aerztlicher Verein Hamburg" a case for differential diagnosis between leprosy and tabes was presented in 1914. It was pointed out that disturbances of sensibility and rarefaction of bones occurred in both diseases when changes in joints were observed, and that hypertrophic bone growths do not occur in leprosy as such but, when occurring, are due to a mixed infection. The conclusion was that it is a question whether the joint changes found in leprosy are due entirely to diseased nerves or also to conjoint action of local processes.

Osler and McCrae (1911) recognize atrophy of bone and the sloughing off of phalanges as sequelæ.

Neve (1915), reporting a case of leprosy in an Indian soldier, with ill-defined symptoms and questionable physical signs, found the following roentgenological bone changes: entire disappearance of terminal phalanges of most toes; the proximal phalanges greatly decalcified; the distal portions of all metatarsals extraordinarily thinned; the thumbs and terminal phalanges of the fingers peculiarly eroded and shaped like pollarded willow trunks; and the terminal phalanx of index finger a mere stump.

Hassim, Burke and Nuzum (1915), in a case of anesthetic leprosy, include roentgenograms showing an osteoporotic condition of the bones, lack of lime salts and atrophy of the metacarpals. Such bone changes, the authors state, have been and are considered characteristic of leprosy occurring in the early stages of the disease.

To tabulate the results of these investigations it is necessary to divide the same into the two main types of leprosy, and besides under the main bone changes as follows:

Nodular Leprosy

True Bone Absorption
Leloir
Sawtschenko
Baelz*
de la Camp*
Hansen and Looft
Deycke
Hirschberg and Biehler†
Jadassohn

Periostitis
Sawtschenko‡
de la Camp†
Hallopeau and Lebret
Hirschberg and Biehler

Ostitis
Hirschberg and Biehler

Osteomalacia
Leloir

Osteomyelitis
Hansen and Looft

Leproma
Deycke
Hirschberg and Biehler

Exostosis
Hallopeau and Lebret

Necrosis
Hansen and Looft
Jadassohn

Atrophy
Jadassohn

* Considered as a combined process of ulceration and resorption.
† As being also due to bacilli.
‡ As occurring only with outside skin ulceration.

Nerve Leprosy

True Bone Absorption
Kalindero*
Miura*
Scheube*
Deycke*
Hirschberg and Biehler*
Sawtschenko*†
Harbitz*
Herrick and Earhart*†
Dyer and Hopkins*
Miller
Colombier‡
Aerztlicher Verein*†
Neve
Hassim, Burke and Nuzum

Necrosis§
Black*
Abraham
Scheube
Dyer and Hopkins
Dyer
Lenoble and Barron*

Osteomyelitis
Hirschberg and Biehler
Harbitz
Herrick and Earhart

Periostitis
Hirschberg and Biehler
Harbitz
Herrick and Earhart

Osteomalacia
Kalindero

Atrophy
Harbitz
Herrick and Earhart
Neisser*
Dyer
Osler and McCrae
Neve
Hassim, Burke and Nuzum

* Considered as entirely secondary to nerve disturbances.
† As being due to bacilli.
‡ Presumed to be a nerve type of leprosy.
§ Necrosis should be considered as an end result to the other single or combined bone changes. It is also understood that the above bone changes are in most instances combined in the observer's description. It is evident, too, that there is definite diversity of opinion regarding the type of bone changes in both nodular and nerve leprosy.

PATHOLOGICAL CHANGES OF THE NERVOUS SYSTEM AND OTHER TISSUES

Investigators do not agree regarding the presence or absence of acid-fast bacilli in nerves, muscles, bones or joints. Two main opinions exist regarding the initial affection of the nervous system in the *nerve type of leprosy*. Lie believes the nerve endings to be first attacked, followed by an ascending neuritis, to which apparently Gluck agrees. On the other hand, Chassiotis does not believe anesthetic leprosy to be a disease of the peripheral nervous system, without involving also the central nervous system. Looft demonstrated lesions in the spinal cord, degeneration and atrophy of the posterior roots and spinal ganglia and a chronic neuritis in the peripheral nerves. His belief is that the posterior roots and ganglia are primarily affected and the spinal cord secondarily; also that paralysis occurring in leprosy is peripheral. Babes found the bacilli in the Purkinje cells of the spinal cord and spinal ganglia. He also states that if the disease is recent, bacilli are present in the nerve fibers and thickened nerves, but later in the disease the bacilli are lacking. Sudakewitsch found bacilli in the ganglia cells of the sympathetic nervous system, and Arning demonstrated bacilli in nerve tissue and other tissues in both types of cases. Hirschberg-Biehler believe the changes found in the central nervous system—i.e., atrophy of spinal cord, degeneration and sclerosis of posterior roots of spinal cord, sclerosis of posterior pyramid roots and lateral roots, slight degeneration of Clarke's column and changes in ganglia cells—are partly due to bacteria direct and partly to suppurative toxins. The bacilli were not demonstrated in the bone marrow. De la Camp was unable to demonstrate the bacilli in the tibia in his case. Kalindero is convinced that the bacilli are not found in bone marrow in nerve leprosy. Deycke is not so decided as to the detailed causes of the bone changes, but believes nerve innervation is primary. Harbitz, upholding the neurotrophic theory in the nerve form, gives the following histological findings:

"The median nerve near the wrist showed concentric thickening of the perineurium of each nerve bundle and slight lymphocytic infiltration; also increased interstitial tissue within the bundle, i.e., endoneuritis. There was marked thickening of the endoneurium in which only here and there few and partly atrophic nerve fibers were seen. There was marked round-cell

infiltration of the ulnar nerve at the wrist. The interstitial tissue was increased and almost no nerve fibers were demonstrable. Scattered in this granulation-tissue, there were numerous heaps of bacilli which stained red and were generally intracellular. In the radial nerve near the wrist there was proliferating connective tissue without nerve fibers with scanty lymphocytic infiltration, and exceedingly numerous and large heaps of bacilli generally arranged longitudinally and located intracellularly."

In the nodular type of leprosy the pathological changes are less complicated but more extensive. Sawtschenko found in the spongiosa nodes without bone trabeculæ and in the surrounding bone tissue an osteoporotic process and no periostitis. These changes are caused by bacilli reaching the bone marrow with the blood in the lymphoid elements, blood vessel endothelium and connective tissue cells. The bone resorption arises through nutritive disturbances and direct bacillary action on the cells. As a result of the inflammatory bacillary action, there arises in the bone marrow and in the bone substance fibrous connective tissue. In the red bone marrow leprous nests can be seen macroscopically; microscopically, fat infiltration, granular and local infiltrated nests with part lymph cells, vacuolized, part connective tissue cells with bacilli and giant cells filled with bacilli. The bone substance is affected after the bone marrow; there then occur the same rarefaction and resorption in the bone laminæ, adjoining the bone marrow, osteoclasts in Howship's lacunæ and in the Haversian canals. A similar process occurs from the periosteum. Gluck found porous thinning, rarefaction, disseminated necrosis, caries, softening and bending. Hirschberg-Biehler, Bordoni-Uffreduzzi found bacilli in the bone marrow; Sawtschenko in the bone and periosteum. Hirschberg-Biehler state that especially in nodular leprosy the periosteal inflammation precedes the exostosis formation. It is a true and specific periostitis with or without exostosis formation.

Deycke and Hirschberg-Biehler describe another form of bone change in which there is a circumscribed bone leproma formation. These growths are surrounded by a distinct sclerotic bony wall.

In summarizing the results of the more important investigations, the following conclusions seem logical:

(a) Both the central and peripheral nervous system are directly attacked and affected by the bacillus in the nerve form of leprosy.

(b) Since such nerve function is interfered with, and as a direct result, there is bone nutrition disturbance.

In the cases under observation, the bones of the hands and feet were affected; there were also skin anesthesia and pigmentation of different parts of the body, indicating peripheral nerve involvement, while there were no symptoms to indicate an involvement of the central nervous system. Investigators are agreed that a degenerative process occurs in the nerve form of leprosy. It is of secondary importance, in considering the bone changes in true nerve leprosy, to what extent the central nervous system is affected, as the lesions under observation were in the bones of the extremities. Of greater interest would be to what extent the other tissues are directly affected or invaded by the bacilli. Babes found in a nerve case characteristic bacilli in the tendon of an affected finger, the tendon presenting the classical inflammatory signs. Arning found the bacilli in the tissues other than the nerves, and other investigators report the same results. The acceptance of these points simply indicates that bone changes from the periosteum may occur simultaneously with the atrophic changes due to nerve changes controlling the bones involved. Absorption of lime salts is the third step after nerve involvement and nutritive disturbances. In the cases presented there will be found some in which two and more processes are going on simultaneously in the same bone.

In nodular leprosy numerous investigators have described inflammatory changes

in the medullary canal, corticalis, periosteum, diaphysis and epiphysis, and joint surfaces. These descriptions do not materially differ from that of Sawtschenko. Atrophic changes, comprising diminution in size, change in shape and outline, absorption of bone salts and ultimately the bone itself, have received due attention. The conclusions of these investigators which have been apparently accepted are that detailed changes in bones are due to acid-fast bacilli or toxins and in some cases also to degenerative nerve changes and sometimes to mixed infections. With one exception, there is no discussion of any other reason for the various bone changes in a single case; the different bone lesions in different cases; the same changes in separate types of the disease; the advanced bone changes in so-called early cases, and vice versa. Deycke suggests that the process of decalcification may be due to an acid or acid salt condition, whereby the neutralization of the acid principle would be released through disturbed nerve innervation.

BONE CHANGES IN OTHER DISEASES

To understand the bone changes in leprosy, especially in the nerve form, it is necessary to consider similar bone lesions occurring in other diseases.

Sudeck describes a high grade speckled, flaky-like atrophic appearance of the spongiosa and corticalis in acute bone atrophies. The structure is entirely wanting and presents a resorbed appearance with irregular small spaces as a result. These appearances were especially noted in the carpal and metacarpal bones and phalanges. With massage and treatment recovery is as rapid as the occurrence of the bone changes.

Nonne found typical atrophic changes, i.e., rarefaction and lack of detail of bone structure, in a series of cases of poliomyelitis with paralysis. These changes were mostly observed in the bones of the hands and feet, especially in the epiphysis. This was seen also in a case of lues with myelitis transversa and in a case of hemiplegia with muscular atrophy of the hand.

Exner, describing changes in acute bone atrophies, reports two forms, characterized by a confused flakiness and rarefaction of the sharply delineated bone beams. This may occur alone or in combination and is in agreement with other investigators. In tuberculosis he found that the spongiosa was first affected. The chemical analysis in three cases of tuberculosis showed that the weight of the lime salts of the metatarsus and metacarpus decreased only by a thousandth part as compared to the normal.

Shenton, in agreement with other observers, states that the longer an inflammatory process proceeds, the more easily may the thinning of the mineral matter and the excavation be recognized. Irregular hollows with ragged outlines are the rule in an acute stage, the bone disappearing as if by dissolution.

In chronic arthritis, as pointed out by Bythell and Barclay and others, an atrophy occurs of the articular cartilages with narrowing of the joint spaces and atrophy and erosion of the bones of the joint. The articular rarefaction is greatly increased and the erosion may lead to marked changes in their outline.

In active osteomyelitis the bones show the walls of cavities to be irregular and necrotic with a marked loss of lime salts; when the disease becomes quiescent, the border-line between diseased and healthy bone becomes definitely demarcated. The inflammatory and destructive process may involve the whole bone and all parts of the bone, or may be localized in a very small area. The diaphysis is most often only and primarily affected.

In tuberculosis the bone may show rarefaction in its early stages, successive changes of rarefaction, lack in detail of structure, necrosis and cavity formation, locally and usually in the epiphysis or in the carpal and tarsal bones. When the diaphysis is affected, a localized focus is most common, necrosis following with outer periosteal changes. Tuberculosis, especially of joints, causes a marked periostitis, a great deal of bone salts is absorbed, fol-

lowed by rarefaction, necrosis and great destruction of the bone. When the small bones of the hands and feet are affected, the bone detail is more obscure.

In osteomalacia the mineral salts, especially lime salts, are decreased. McCrudden states that the relative amount of inorganic matter is decreased and the amount of organic matter increased. Calcium in dried bone was found to be decreased to nearly one-half the normal. Magnesium salts, however, were increased, McCrudden concluding that the acid theory as a cause of bone changes could be discarded, as magnesium phosphate was more soluble than calcium phosphate, and also that there were other disproportionate amounts of bone salts. McCrudden's summary is "that in osteomalacia the proportion of inorganic constituents is decreased and the proportion of organic constituents increased. The decrease in the proportion of inorganic constituents is due to a loss of calcium phosphate. The proportion of magnesium phosphate and of the organic matrix of bone is increased. The increase is greater than can be accounted for by simple decalcification, so that we must assume that it is due to material newly laid down to replace the calcium phosphate."

In osteomalacia, osteoid tissue is produced in the interior of the bone not unlike that found in rickets, which occurs between diaphyses and epiphyses and beneath the periosteum. Osteoblasts are abundant in osteoid tissue in the bones of osteomalacia, and another point in contrast to our findings in leprosy is von Recklinghausen's statement, quoted by McCrudden, that good callus formation often occurs in osteomalacia. Roentgenograms show a rarefaction of the bones and often exostosis, increased thickness of the bone which is often irregular, tumor-like and of a consistency much less dense than normal bone. It usually involves the whole length of the long bones.

In osteitis deformans the process is similar. The condition is generally one of local osteomalacia, although roentgenograms of long bones and the cranial bones in cases under my observation present changes in all portions of the bone of an inflammatory type very dissimilar to osteomalacia.

CASE REPORTS

CASE I.—A Portuguese gardener and cook, male, single, 26 years old and for 7 years in this country, was admitted in an actively progressive stage of advanced nodular leprosy. The condition was first correctly diagnosed 3 years ago.

FIG. 1.—ADVANCED NODULAR TYPE OF LEPROSY.
Left hand. Advanced bony changes. Rarefaction, absorption, opaqueness of joint space, periostitis.

The roentgenogram of the left hand shows advanced changes as evidenced by the total disappearance of the terminal phalanx, little finger, most of the terminal phalanx, index finger, and middle phalanx, little finger. The crowns of the remaining fingers have also been absorbed. A rarefying process is seen most markedly in the first phalanx, little finger; middle phalanx, ring finger; terminal phalanges, middle and ring fingers. Some thinning also occurs in the distal ends of first phalanges, middle and ring fingers; middle phalanx, middle and fifth metacarpal.

The detail bone structure of the first finger is obscure. The middle phalanx of the middle finger shows a curious blotchy character, due to areas of transparency in an opaque substance.

Apart from the thinning of the first phalanx of the little finger there is also some atrophy of the whole bone. The terminal phalanges of the middle and ring fingers have a clear-cut abrupt ending.

The phalangeal joint spaces and the metacarpo-phalangeal space of the index finger show opaqueness, while the terminal space of the index finger is entirely obliterated. Some question of periostitis of the middle phalanx of the index finger (both sides) arises.

Right hand shows advanced changes, most marked in little finger. The terminal phalanx has disappeared, the middle phalanx shows thinning and the first phalanx shows absorption of nearly one-half its entire head, with evidences of a periostitis. The crowns of the index, middle and ring fingers have nearly disappeared. The heads of the first, all of the middle and the terminal phalanges of the index, middle and ring fingers show a thinning of the bones.

FIG. 2.—ADVANCED NODULAR TYPE OF LEPROSY.
Right foot. Advanced bony changes. Absorption, rarefaction.

In the metacarpal head of the index finger is a circular clear area one-fourth the size of the entire head of the bone.

The shaft of the first phalanx, ring finger, shows a slight periostitis on its inner aspect.

All joint spaces excepting those of the thumb show an opaque and rather marked density in the index, middle and ring fingers. (Fig. 1.)

CASE II.—A Chinese, married, 36, engaged in washing and housework, and resident of the United States for 13 years, suffered from the nodular type of leprosy, a diagnosis of which was made 10 years ago. The present condition of the disease was advanced and active, with pustules, nodules and marked induration, pain, chills and local swelling. The lower legs were the most severely affected parts of the body.

The roentgenogram of the right foot shows definite advanced changes in all the phalanges. The middle toe bones have almost entirely disappeared, leaving only the distal end of the first and the proximal end of the middle phalanges. Atrophy and thinning of the terminal phalanges of the 4th and 5th toes are seen, also thinning of all phalanges. The crown of the terminal phalanx of the great toe is almost completely absorbed. The two phalanges of the great toe show an irregular thinning and in the first phalanx are many minute, distinct areas of transparency. The joint spaces of the great toe are somewhat opaque. The heads of the metacarpi are slightly thinned, especially that of the great toe in which several very small, clear areas are also seen.

The roentgenogram of the left foot shows less advanced changes, but a more consistent, regular thinning of all the phalanges and of the heads of all metacarpi as well as more of the shaft of the great toe. In most of the phalanges there are many minute transparent areas, occurring mostly in the distal third of the bones. The terminal phalangeal crown of the great toe is almost absorbed, and the remaining terminal phalanges are somewhat atrophied. All the joint spaces are somewhat opaque. The most interesting feature, as well as the greatest contrast, is seen in the middle of the shaft of the first phalanx of the great toe, where there is a distinct demarcated area

of fairly normal bone in contrast to the regular rarefaction of both ends. (Fig. 2.)

CASE III.—A 50-year old Russian, married, suffered from nodular leprosy in a slowly active stage. First diagnosis 9 years ago. There were bullæ, ulcers, swollen glands and marked induration. The symptoms consisted in pain, chills, swelling and considerable throat troubles. Occupation, cooking and light house and garden work.

Roentgenogram of the Right Hand. The little finger, at its second articulation, is bent sharply at right angles to the hand, the 2nd and 3rd articular surfaces are ankylosed; there is also slight atrophy of the last two phalanges and marked rarefaction of the head of the first phalanx.

All the phalangeal and the 2nd, 3rd, 4th and 5th metacarpal bones show rarefied changes due to lime salt absorption. The greatest change, which is of an irregular, blotchy character in the entire substance of the bone, with the exception of a thin cortical layer, is seen in the 5th metacarpal and the first and middle phalanges of the middle and ring fingers. Similar changes occur also in the upper half of the 2nd, 3rd, and 4th metacarpi and in the phalanges of the index finger. All the phalangeal and metarcarpo-phalangeal joint spaces are opaque, but more marked in the 4th finger.

Prognosis unfavorable. Patient died in 1915. (Fig. 3.)

CASE IV.—The type of leprosy in this case, which was diagnosed 7 years ago, was of a mixed character and in a slowly active stage. The patient was 71 years old, a Russian Jew who had lived in this country for 16 years. There were ulcers, pain, diarrhea, and troubles in the throat, mouth, bowels and bladder. Prognosis unfavorable.

Roentgenogram of the Left Foot.—Slight atrophic changes of the first phalanges of second, third and fourth toes occur, as shown by a decrease in the circumference of the shafts.

The right foot shows slight atrophic changes also, although more marked than is seen in the toes of the left foot. These changes, however, occur in only the first phalanges of third and fourth toes.

CASE V.—The diagnosis in this case was made 2 years ago. The patient was a Russian Jew, single, who had lived in this country for 9 years, doing light house and garden work. The disease was of the nodular type in an early stage. There were bullæ, ulcers, small tubercles, and eye and throat troubles. Prognosis favorable.

Roentgenogram of the Left Hand.—In the first phalanges of the middle, ring and little fingers, middle phalanges of first and little fingers, and in the terminal phalanges of the middle and ring fingers are several

FIG. 3.—NODULAR TYPE OF LEPROSY.

Right hand. Joint space opaque. Ankylosis, periostitis, cysts.

minute transparent areas. Very slight thinning occurs in the phalanges of the little fingers, ends of the middle phalanges and the terminal phalanges of the middle and ring fingers. Slight periostitis is seen in the first phalanges of the middle and ring fingers. The second and third phalangeal spaces are slightly opaque. All the changes present are the earliest seen in any of the cases. It is a typical nodular case with no ulceration of the tissues and no apparent nerve involvement.

CASE VI.—This patient was a Portuguese woman, 53 years old, and married. Residence in this country 11 years. Diagnosis made 6 years ago. Anesthetic type of disease. Stage and condition of disease

latent (?). There were ulcers and blebs due to burns. There were no marked symptoms and the patient was in an excellent physical condition, offering a favorable prognosis.

The roentgenogram of the left foot presents marked changes almost entirely limited to the great toe and the bones of the little toe. There is some difficulty in determining the exact position of the terminal phalanx, great toe. Absorption of the greater part of the bone has undoubtedly occurred, but whether the remaining portion of the phalanx has been displaced is undetermined. The first phalanx shows an irregular, blotchy thinning and at its proximal end there is a small, clear, transparent area. The little toe shows absorption of the larger part of the first phalanx and the entire head and part of the shaft of the metatarsus. There is also seen a distinct periostitis of the inner side of the shaft of the fifth metatarsus. The changes seen in the bones of the little toe are the typical neurotrophic changes to be expected, but the changes in the terminal phalanx of the great toe are more consistent with inflammatory disturbances and in this particular case there had been a perforating ulcer about a year previously, but it is interesting to note that there is no periostitis in the rest of the bone.

FIG. 4.—TYPICAL ANESTHETIC OR NERVE TYPE OF LEPROSY.

Deep ulcer under base of great toe one year previous. No other ulceration of tissues of foot. No infiltration of skin.

Left Hand.—On account of the contracture of the fingers difficulty was experienced in obtaining a good roentgenogram. The changes, however, are very slight, there being only a slight periostitis of the first phalanx, middle finger, ankylosis of the first and middle phalanges, little finger, and some atrophic changes of the middle and terminal phalanges of little finger. (Fig. 4.)

CASE VII.—A 36-year old single woman, of Lettish nationality and residing in this country for 17 years, suffered from the nodular, "leonitic" type of leprosy, the disease being diagnosed 8 years ago. Stage of disease fairly active, progressive. There were bullæ, ulcers, swelling of glands, etc., marked induration, nodules, with local and rheumatoid pains, headaches and chills. Patient is very active in housework. Prognosis unfavorable.

The roentgenogram of the left hand shows clearer cut and more advanced changes than those of the right hand. The first phalanges of all the fingers show typical absorptive changes both in the substance and outline. All the phalanges and the fifth metacarpal bone show thinning, most marked in the terminal phalanges of the four fingers and in the middle phalanx of little finger. The first phalanges of the fingers present that irregular, blotchy character previously described; this advanced stage is seen in the first phalanx of little finger, where a number of small, clearly defined, clear spaces occur in a more or less opaque surrounding, indicating irregular absorption of bone salts. All phalangeal joint spaces are opaque and several are entirely obliterated and again most evident in the little finger.

Right Hand.—The bones are massive, consistent with the outer appearance of the patient's hands. All the phalanges of the first and second row of the fingers show a blurring character, not unlike the appear-

FIG. 5.—NODULAR TYPE OF LEPROSY.

Left hand. Joint spaces opaque and obliterated. Rarefaction, periostitis, cysts.

FIG. 6.—NODULAR TYPE OF LEPROSY.

Left hand. Advanced bony changes. Absorption, rarefaction, irregular blotchy thinning.

FIG. 7.—NODULAR TYPE OF LEPROSY.

Right foot. Early bony changes. Rarefaction, exostosis.

FIG. 8.—NODULAR TYPE OF LEPROSY.

Left foot. Rarefaction, slight periostitis.

ance seen in bone tuberculosis. The curious blotchy appearance of the bones is evidenced in some of the phalanges. Periostitis of the first phalanges, ring and little fingers, and a slight periostitis of the same phalanx of middle finger. The terminal phalanges of all the fingers are thinned, pointed, and much accentuated on account of the massiveness and opaqueness of the other phalanges.

The phalangeal joint spaces are opaque, especially those of the middle and ring fingers.

Right Foot.—Very slight changes are seen in the foot. The terminal phalanx of the great toe and the first phalanges of the second, third and fourth toes show some thinning. In the fourth toe the thinning is shown by several small clear areas. The terminal phalanx of the fifth toe presents two small exostotic processes.

Left Foot.—The bones are practically

FIG. 9.—EARLY NODULAR TYPE OF LEPROSY.
Left hand. Thinning, some irregular absorption.

unaffected, excepting a questionable thinning of the middle phalanx of the second toe. Slight periostitis. (Figs. 5-8.)

CASE VIII.—A Greek, aged 27, single, whose diagnosis of leprosy had been made three years ago, had the typical nodular type of the disease in a fairly active, progressive stage. Few small ulcers and nodules. Complained of pain and chilliness. Prognosis fairly favorable.

The roentgenogram of the right hand shows very early changes in the bones, mainly in middle phalanx of middle finger. Three small clear semicircular spaces are seen in the proximal end, extending upward to the middle of the shaft. The minute structure of the bones is not distinct, showing a somewhat vague but minute blotchy appearance.

The left hand shows a very slight and delicate thinning of all phalanges. In the distal end of the first phalanx of the index finger there is a small semicircular clear area. The bones are very nearly normal in appearance. (Fig. 9.)

CASE IX.—An unmarried Chinese, 39, who has lived in this country for 15 years, had a diagnosis of leprosy made three years ago. The disease is now in an active condition, with pustules, nodular glands, pain and considerable eye trouble. Occupation light house and garden work. Prognosis unfavorable. The affection is of the maculonodular type.

The roentgenogram of the right hand presents early changes as seen by slight atrophy in phalanges of little finger, most noticeable in terminal phalanx.

In distal ends of middle phalanx and in the proximal ends of the terminal phalanges of ring and little fingers, some thinning of the bones occurs. In the distal ends close to the juncture of the shaft of middle phalanges of the ring and little fingers, there is a small distinct semicircular clear area.

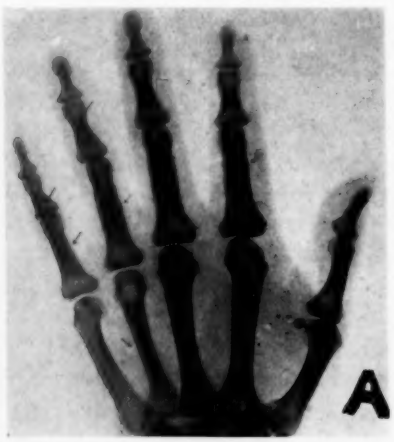

FIG. 10.—MACULONODULAR TYPE OF LEPROSY.
Right hand. Bony changes. Atrophy, thinning, joint space opaque, slight periostitis.

FIG. 11.—MACULONODULAR TYPE OF LEPROSY
Left hand. Early bony changes. Thinning, joint space opaque, irregular absorption.

All phalangeal joint spaces are opaque with the exception of the terminal space of the index finger. A slight periostitis is also apparent on the shaft surfaces of the phalanges of the ring and little fingers.

In the left hand early bone changes are seen by the thinning of the distal ends of the first phalanges of middle and ring fingers, and of the middle phalanx of the index finger; of the proximal end of the first and middle phalanges of middle finger and of the middle phalanx of ring finger.

The phalangeal joint spaces of the middle and ring fingers are slightly opaque.

The ring finger position is not straight, owing to a slight displacement of the middle phalanx. (Figs. 10-11.)

CASE X.—Y. T. Sex, male. Age, 35. Social state, married. Nationality, Chinese. Resident in United States, 24 years. Diagnosis of leprosy made 11 years ago. Type of disease, nodular. Stage of disease, advanced. Condition of disease, active, progressive. Most common lesions, ulcers, swollen glands, discharging bullæ and marked induration. Dispensary attendance frequent. Symptoms most marked, pain, chills, headache, swelling, throat, cough. Number of "toxic-febrile" attacks, several, one severe. Activities of patient, washing, gardening, cooking, amusements. Disposition, good. Prognosis, unfavorable. Remarks, throat is troublesome; has "toe drop"—motor paralysis.

FIG. 12.—ADVANCED NODULAR TYPE OF LEPROSY.
Right hand. Advanced bony changes. Absorption, rarefaction, periostitis.

FIG. 13.—NODULAR TYPE OF LEPROSY.
Left foot. Rarefaction, periostitis, exostosis.

Roentgenogram of left hand shows slight atrophic changes in the terminal phalanx, little finger. Some thinning occurs of the distal end of the first proximal, distal ends of the middle and the entire terminal bone of the phalanges, ring finger.

All phalangeal joint spaces are somewhat opaque, especially between the first and middle phalanges of the little finger, where the space is barely discernible. (Fig. 12.)

CASE XI.—Japanese gardener, single, 39, and residing in this country for 8 years, had a diagnosis of leprosy made 5 years ago. Type, nodular. The affection is now in an advanced, actively progressive stage with ulcers, nodules, bullæ, swollen glands, induration, pain and chills. Prognosis unfavorable.

The roentgenogram of the right foot shows an irregular thinning of the first phalanx and proximal end of the terminal phalanx of the great toe. The crowns of all toes are almost completely absorbed. The joint spaces between the first and middle phalanges of the second, third and fourth toes are nearly obliterated and of the fifth toe entirely so.

The roentgenogram of the left foot shows somewhat lesser changes. There is some slight thinning of all the phalanges of the second row, the terminal phalanges of the second, third, fourth and fifth toes and the first phalanges of the fourth and fifth toes. The phalangeal joint spaces are all opaque.

The right hand shows advanced changes in all the phalanges due to lime salt absorption. The only exception is in the middle phalanges of middle and ring fingers. The head of the first metacarpal bone shows an almost complete absorption and disintegration of one-half its entire mass,

The left hand shows an irregular position of the middle, ring and little fingers, due to inward contracture of middle and terminal phalanges of ring and little fingers and to a fracture at the upper third of the first phalanx of the middle finger. The little finger shows atrophic changes, the middle and terminal phalanges being markedly smaller in circumference and giving an awl-shape appearance to the whole finger. The bone shows no rarefaction changes. The crowns of the thumb, index, ring and little fingers have been absorbed. There is a marked thinning of the middle and phalangeal bones of the middle finger.

FIG. 14.—TYPICAL NODULAR LEPROSY.
No deep ulceration. Infiltration of skin.

FIG. 15.—ADVANCED NODULAR TYPE OF LEPROSY.
Left hand. Marked bony changes. Marked atrophy, rarefaction, periostitis, joint space opaque.

giving it an irregular and punched-out outline appearance. The same change is seen in the shaft of the first phalanx of ring finger, and slighter surface changes occur on the inner border of the shaft of the first phalanx of middle finger.

The middle finger presents pronounced atrophic changes, the entire bone being decreased in its width and irregular in outline on its inner border.

All phalangeal joint spaces and the metacarpo-phalangeal space of the index finger are very opaque.

The crowns of the terminal phalanges of thumb and index finger have been absorbed.

The outer surface of the shaft of the first phalanx of ring finger shows an irregularity due to a cortical substance absorption. There are also two small, clearly defined transparent spaces in the shaft of the first phalanx of middle finger, and in the proximal end of the first phalanx of ring finger.

All phalangeal joint spaces are opaque and several are completely obliterated.

The first phalanx of the index finger is somewhat dense, with scarcely any differentiation between cortical and medullary substance, showing a curious blotchy appearance throughout its entire mass. (Figs. 13-15.)

RÉSUMÉ OF AUTHOR'S OBSERVATIONS

From a study of the bone findings here reported there is evidence that, notwithstanding the stage of the disease or even the type, very definite lesions varying in intensity and extent are found apparently irrespective of the general condition of the patient. For instance, Case VIII shows marked inflammatory reaction; there are thinning of the bones, periostitis, obliteration of joint spaces, cysts, and a more marked absorptive process than is shown in Case III, although the latter was in a more advanced stage of the disease and showed an ulcerative condition far greater than Case VIII. Every case showed bone and bone salts absorption to a variable extent. Periostitis is common. Among these cases there are bone changes which evidently arise primarily from the medullary portion of the bone and others primarily from the periosteum. In the absorption process the epiphysis suffers first and most. Cyst or cavity formation is greatest in the diaphysis. Ankylosis occurs, but not healing of fractures, in which salt deposit is necessary. Ulceration of the skin is not necessary, as marked periostitis occurs without any discoverable lesion in the tissues outside the bone. Definite atrophic bone changes, without apparent change in the contour of the phalanx and periosteum, do occur. Atrophic bone changes occur in cases of nodular leprosy, demonstrating the fact that definite nerve disturbances are as much a part of nodular leprosy as inflammatory bone absorption is a part of the process in nerve leprosy. Not in a single case can it be definitely said that the destructive bone process arises internally or externally, for in a single case a periostitis may exist in one phalanx, while in another phalanx the changes are wholly medullary as, for instance, in Case III. One of the most important points of interest is that in cases where skin ulceration did occur, there was no appreciable added change in the underlying bone.

In general, the bone changes observed vary from slight thinning, atrophy or periostitis to advanced changes with total absorption of phalanges, marked inflammatory action in bone, distortion, ankylosis and fractures. Changes may begin in the periosteum, articular surfaces, corticalis or medullary canal, and apparently any of these changes or all of them may occur in the same set of bones. Also the bones of the hands and feet show the changes soonest and to the greatest extent. The tibia was in one case markedly affected, but in a number of cases the ankle joint bones were not affected. A curious exception in the hands was the thumb, the bones here being in but a few cases slightly affected. As has been inferred, the changes expected in the nerve type are atrophic and in the nodular type inflammatory or hypertrophic. In these particular cases the reverse has occurred and both types of changes have appeared in each form.

It should be noted that the causes of the bone disturbances discussed here are not agreed upon by observers. The difference of opinion, however, is more apparent than real, considering that most of the cases have been studied at different stages in different types and in general with limited material; many observers, in fact, drawing conclusions from a single case. Authorities are agreed, however, that the constant inflammation and infiltration of the nerves, in nerve leprosy, definitely interferes with their function. Bacilli in the blood and in the bone marrow also undoubtedly cause inflammatory disturbances with resulting changes in the structure of the bones. But it is doubtful whether the mere presence of bacteria will produce the rarefying changes. Nerve disturbances, it is granted, produce atrophy, as shown in the nerve cases, but do not produce the irregular bone absorption without diminution in shape or form, as seen in the nodular cases. In some cases there was absolutely no outward indication of nerve involvement but nevertheless the bones presented changes which are ascribed to nerve disturbances. In some

cases absorption has followed atrophic changes. Bacteria produce the osteomyelitic and periostitic changes, and such evidence is presented. The distinctive features of cavity formation described by Deycke have been found. Changes in the periosteum, however, may be mistaken for the irregular absorption changes in the cortical seen sometimes in the diaphysis of the phalanges.

It may also be tentatively stated that there are two new points to be considered: that the absorption of bone and bone salts is an early metabolic change and that atrophic bone changes with tissue absorption, if wholly due to nerve involvement, are necessarily earlier than outward manifestations and much earlier than has been realized by investigators.

The following remarks are intended as an incentive to further investigation. Studies of metabolism in certain diseases in which bones are affected, such as osteomalacia, are well known, but I have been unable to establish that such studies have been undertaken in leprosy. As previously stated, the explanations given as to the cause of the bone changes in leprosy do not explain satisfactorily all the changes described. It therefore seems to be essential to undertake such studies, which is now being done, and it is hoped that complete metabolic investigations under ideal conditions will give results.

The value of the results obtained by the examination of the urine in twelve cases for the presence of bone salts is questionable, although it is of sufficient interest to report. The results in amounts given are general rather than specific, owing to unfavorable conditions in conducting these quantitative analyses.

Sodium chloride was found in all cases to be in excess of normal by approximately 1 part per 1000 by weight, phosphorus and sulphur by approximately 0.5; calcium, magnesium and sodium were present in all specimens; albumin and nitric acid also in all cases. In another case of nerve leprosy the urine was examined, previous to having a roentgenogram made of the hands, and the calcium content was found to be double the normal. The roentgenogram showed marked absorption of the bones, expecially of the fourth and fifth phalanges.

It is also of interest to append the findings in the normal condition: The average daily output of calcium in urine and feces, according to Nelson and Williams, was from 0.420 to 1.016 gm. The results, according to Nelson and Burns, of the analysis of the daily output of calcium and magnesium in urine varied from 0.1685 to 0.1468 gm. of calcium and 0.1912 to 0.3130 of magnesium.

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GREATER CERTAINTY IN THE LOCALIZATION OF FOREIGN BODIES IN THE EYE*

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THE localization of foreign bodies in the eye is one of the best successes attained by modern roentgenologists. Yet, although a number of different methods have been devised which are capable of excellent results in skilled hands and in favorable cases, all are liable to certain errors in difficult cases and at the hands of less skilled operators.

The best known and the most reliable, most nearly "fool-proof," of these methods is the use of the Sweet Localizer. It will be assumed that the reader is familiar with the construction of this instrument. If not, he will find the description and method of its application in the *Archives of Ophthalmology*, 1909, Vol. 38, p. 623.

Practically all methods depend on the principle of triangulation, and the position is either calculated from the magnitude and directions of the movements of shadows of the opaque objects under investigation, or by the graphic method which consists in reproducing the lines of projection on a chart and directly measuring the position with relation to a fixed point.

Since neither the eye nor the structures immediately surrounding it offer a point from which to measure these distances, it becomes necessary to introduce into the problem a "marker" which may serve as a base for all calculations, and which must have a definite relationship to the anatomic structures of the eye. Since the position of a foreign body is most conveniently defined by three coördinates measured backward along the optical axis of the eye and in the vertical and horizontal planes about this axis, the "marker" is most conveniently placed on this axis and at a definite distance (one centimeter) in advance of the cornea.

If two exposures are made (preferably on the same plate) and the distances (see Fig. 1) *A-B*, *B-m*, and *Bm″* are known, the coördinates *ab* and *am* may be calculated with little difficulty from the values and directions of *m″b″* and *m′b′*. It is, however, much simpler and quite as satisfactory to use the graphic method, simply plotting out on a diagram the relative positions of the tube, the marker, the shadow of the marker and that of the foreign body, and measure the distances directly in millimeters. The plane of projection need not be, and rarely is, the frontal plane of the body, and proper cor-

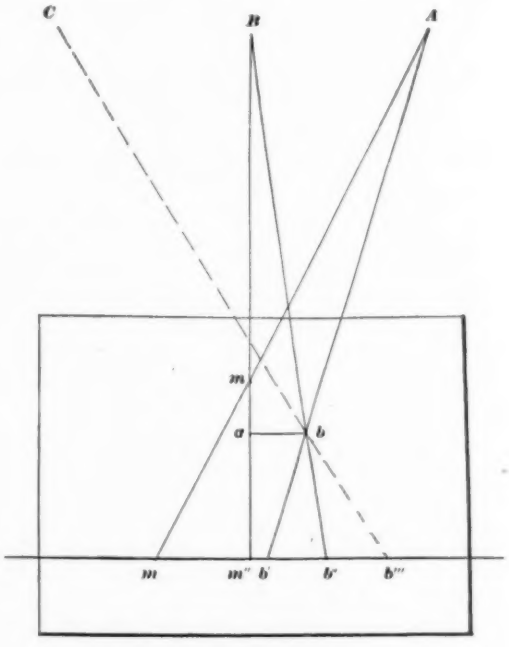

Figure 1

*Read at the Midwinter Meeting of the Western Section of the American Roentgen Ray Society, Cincinnati, February 22, 1917.

rection must be made to bring them into that plane, either before or after reconstruction.

If the scale of the reconstruction is reduced, its accuracy is reduced in the same ratio, while a full scale reconstruction is inconveniently large. The measurement of these distances and the determination of the angle of the plane of projection with reference to the plane of the plate and to the frontal plane of the body are matters of considerable delicacy and of great importance to the accuracy of the localization.

Dr. Sweet, in his "Localizer," has combined all of these factors and has built them into his apparatus so that the diagram, or "chart," can be constructed once for all, and the only portion of it that need be considered is that including the eye and the roentgen plate, *i.e.*, the portion included within the solid lines in Fig. 1. Moreover, Dr. Sweet has selected such an angle of projection as will throw the shadow of the eyeball as much as possible "in the clear" of confusing shadows thrown by the dense bones of the skull surrounding the eye. He has selected a position of the tube not in the frontal plane of the cornea, but approximately 24° in advance of this position, and the correction for this obliquity of projection is included in the chart. An intricate problem has been reduced to its "least common denominator," and the determination of the position of a foreign body with reference to the marker is made a purely mechanical matter, well within the reach of the average operator.

To facilitate the localization with reference to the anatomic structures of the eye, Dr. Sweet introduces the outline of the average normal eye in its proper relations and the position of the foreign body is revealed at a glance.

This apparatus is scientifically correct in principle, rigid in construction, and easy in application, and should give reliable results. Unfortunately, errors frequently creep in, and the ophthalmologist is quite justified in requesting repeated examinations by this method in important cases.

It is the purpose of this paper to analyze the sources of these errors and their remedies.

The localization of a foreign body with reference to the anatomic structures of the eye rests on three assumptions: (*a*) that the outlines inscribed i the chart correctly represent the size a d shape of the eye under examination; (*b*) that the position of the marker with reference to the axis of the eye and to the surface of the cornea is as represented; and (*c*) that the foreign body has held the same position in space during the two exposures, *i.e.*, that neither the foreign body has altered its position in the eye (*e.g.*, in the vitreous) nor the eye has been moved or rotated.

The size and shape of the human eye are remarkably constant for all individuals and all races, and its anteroposterior diameter is approximately 24 mm. The maximum and minimum for the emmetropic eye are given by Schnabel and Herrenheizer ("Über Staphyloma posticum, Conus and Myopie," *Zeitschr. f. Heilkunde*, Bd. 16, 1895) as 26 and 22.5, respectively. Since the thickness of the coats of the eye from the retina to the outer surface of the sclera is less than 2 mm, this variation is sufficient to place the foreign body on the wrong side, within or without the eyeball, as the case may be. This error is of serious moment only in the posterior hemisphere, since it becomes progressively larger as we pass from before backward, becoming greatest at or near the fovea.

The variations from this standard eye with the age of the patient are also considerable. At birth, the same diameter has a value of from $16^{1}/_{19}$ of a mm (von Jaeger). Its axial diameter is further modified by disease—ametropia, staphyloma, loss of fluid contents of the eye, etc.—the latter often occurring as a complication in foreign body cases.

Judgment of this factor, however, should not fall within the province of the roentgenographer, but should be left to the ophthalmologist who may have very definite ideas on the subject derived from the clinical examination of the case. It is merely intended here to call attention to the liability to such errors and their probable magnitude. It should not be forgotten that the actual localization is made with reference to the marker and not with reference to the anatomic structures of the eye.

In dealing with intelligent patients who have not lost the vision of the injured eye, the placing of the marker is not a matter of great difficulty. But we are often asked to determine the position of a foreign body in a sightless eye, usually with a marked deviation, where Dr. Sweet's direction to have the patient fix with the seeing eye on the image of the marker in a mirror provided for that purpose but fails to bring the eye under examination into proper alignment. Or, perhaps, we are confronted with the impassable barrier of a difference of speech or a lack of intelligence. And yet the exact placing of the point of reference is as important as the remainder of the process, since every error at this stage is faithfully reproduced by an error in like sense and of the same magnitude in the final determination. We labor under the impression that most of our errors have arisen from this difficulty. So we have returned to the method of selecting some point on the wall or ceiling upon which the patient may fix with the well eye, so chosen that the axis of the injured eye will have the proper direction.

Slight movements of the eye during the exposure result in a loss of sharpness of definition in the shadow, even to its complete disappearance. Any difference in the sharpness of the two images should lead to a rejection of the plate as an unreliable index to the position of the foreign body on the grounds of improper fixation. Not infrequently the position of the eye is changed between the first and second exposures, either by a slight rotation of the eyeball, or by a slight change in the position of the head. The effects of such movements may be best studied by the graphic method (Fig. 2).

Let us assume that the placing of the marker at the beginning of the experiment was correct and that the movement occurred during the interval between the

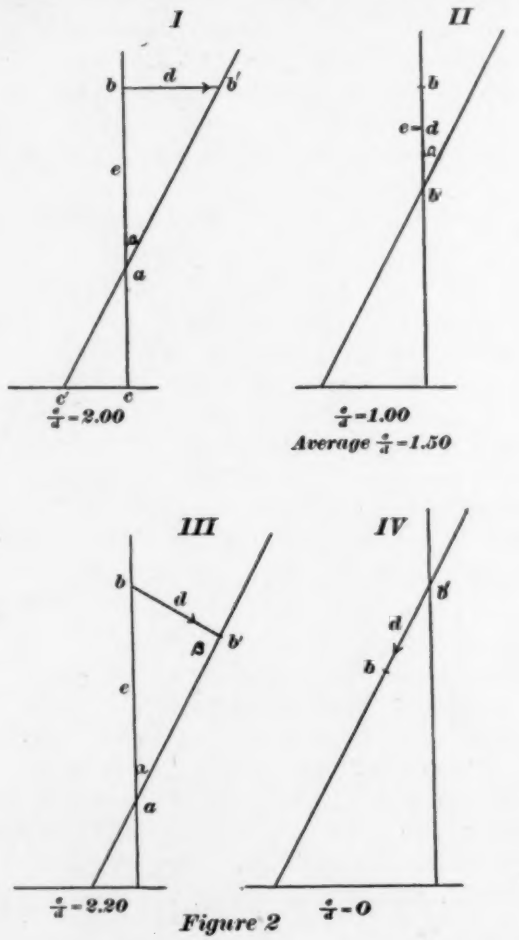

Figure 2

two exposures. We may then represent the original position of the foreign body by b and the subsequent position by b'. All motions in the given plane may be resolved into two components at right angles. Let us consider separately the vertical and lateral components of movements in the plane of the two successive positions of the focus spot and of the marker. This is the plane of the "front view" of Dr. Sweet's chart. In our dia-

gram, we may use the same lettering throughout and by selecting similar magnitudes for our movements obtain directly comparable values. For the slight distances we are considering, the differences in the angles due to the radial projection of the beam of rays from the focus spot of the tube are so slight as to be negligible, and approximately equal to the angle *A m B* of Fig. 1, which is approximately 26° 30′ in the Sweet apparatus.

CASE I. *Horizontal Displacement.*—The foreign body at *b* casts the shadow *c* on the plate. Before the second exposure it is assumed to have moved to *b′*, through the distance *b b′* which may be termed *d* (displacement). It now casts a shadow at *c′*. When the reconstruction is attempted, the lines *b c* and *b′c′* are found to intersect at *a*, the indicated position of the foreign body at a distance *b a* from its true position. This represents the error and may be represented by the letter *e*. The ratio $\frac{e}{d}$ may be taken as a measure of the error in the comparison of a series of cases.

In this case, $b\,b' = b\,a \tan \alpha$ and $b\,a = b\,b' \operatorname{cotan} \alpha$

$$\frac{b\,a'}{b\,b'} = \frac{e}{d} = \operatorname{cotan} 26^\circ\,30' = 2.00,$$

that is, the error is 2.00 times greater than the displacement.

CASE II. *Vertical Displacement.*—Here the reconstruction brings the intersection of the two lines at the point *b′* which was the true position of the foreign body at the time of the second exposure, but is false with respect to the position of the marker. The displacement here equals the error and $\frac{e}{d} = 1$.

CASE III. *Maximum Error.*—The maximum error will occur when the direction of the displacement is at right angles to the direction of the oblique ray. In this case, $b\,b' = b\,a \sin \alpha$, and $\frac{b\,a}{b\,b'} = \frac{1}{\sin \alpha}$; $\frac{e}{d} = \frac{1}{\sin} 26^\circ\,30' = 2.23$.

CASE IV. *Minimum Error.*—If the displacement is in the direction of the projection of the succeeding ray, the reconstruction places the foreign body correctly and the error is zero.

We may assume that the liability to displacement is equal along the two components and the average of the two values of $\frac{e}{d}$ is the average error. The average error in any direction is therefore 1.50 times the displacement with a maximum of 2.23 and a minimum of zero.

This assumption is open to the very serious objection that the displacement is not apt to occur along either of the main axes, while in any other direction the error will not be represented by one-half of the sum of its two components but by the square root of the sum of their squares. A fairer assumption is that the displacement is equally apt to occur in any direction from the original position of the foreign body. On this basis it develops that the general expression for the ratio of error is

$$\frac{e}{d} = \frac{\sin \beta}{\sin \alpha}$$

where α is the angle produced by the movement of the tube along its carriage, and β is the angle between the line representing the direction of displacement and the line of projection in the subsequent exposure.

From this expression, the four special cases just discussed are easily derived by the substitution of the proper values of α and β.

We may now accurately determine the average values of the ratio $\frac{e}{d}$ by integrating this expression for all positive values of $\frac{e}{d}$ (*viz.*, between $\beta = o$ and $\beta = \pi$), and dividing by π. The resulting average is

$$\frac{2}{\pi \sin 26^\circ\,30'}$$

which equals 1.42.

Considering the average value of $\frac{e}{d}$ through all values of β as expressed by the term $\frac{2}{\pi \sin \alpha}$, we see that its absolute value decreases as the absolute value of $\sin \alpha$ increases. But the maximum value of $\sin \alpha$ is reached when $\alpha = 90°$. The minimum value of the expression $\frac{2}{\pi \sin \alpha}$ then becomes $\frac{2}{\pi} = .637$.

Theoretically, then, the optimum conditions require us to make two exposures at right angles, which is physically impracticable. The value of the angle α can, however, be doubled by the simple expedient of using the positions *A* and *C* (Fig. 1), instead of *A* and *B* as advised by Dr. Sweet. Under these conditions $\alpha = 53°$ (nearly); $\sin 53° = .798$; and $\frac{2}{\pi \times .798} = .806$. That is to say, by using the extreme positions of the tube on the carriage instead of the mean and one extreme, the probable error can be reduced from 1.42 times the displacement to .806 times the displacement.

Dr. Sweet's objection to this method, that the shadow of the foreign body is apt to be lost in the dense shadow of the temporal bone, seems to us to be not well taken. With the refinements of technic made possible by the use of the Coolidge tube, there should be very little difficulty except with the relatively transparent materials such as wood. Indeed, there is no objection to the use of the B position in addition to the other two, inasmuch as it offers other advantages which will be mentioned in detail later. In the cases we have examined since we have adopted the three exposures on the same plate, we have not failed to show three shadows with sufficient clearness to serve as localizing points.

The most important advantage in the triple exposure lies in the fact that it furnishes three separate triangulations for the localization of every point instead of one. In the reconstruction, the projection lines should meet at a common point, representing the position of the foreign body. If they do not, there has been an error, either in the centering of the tube, in the reconstruction, or in the fixation of the eye. The diagram will show a small triangle and the size of the triangle is a rough measure of the degree of the error. If the triangle is very small, the examination may be accepted as satisfactory; if not, it should be repeated. In case the examination can not be repeated for any reason, considerable information may still be obtained from a consideration of the size and shape of the triangle. A study of these triangles is presented in Figs. 3, 4 and 5.

Three conditions enter into the problem: (*a*) the order in which the exposures are made; (*b*) the direction of the displacement; and (*c*) the time relation of the displacement with reference to the exposures (*i.e.*, whether between the first and second, or the second and third exposures). In every case the direction of the displacement is indicated by an arrow along its path, the magnitude of this displacement being the same. Beneath each diagram is given the calculated value of $\frac{e}{d}$, assuming the adoption of the apex, *a*, of the triangle as the probable position of the foreign body, this point being at the intersection of the lines of projection with the tube in the "extreme" positions.

The diagrams representing conditions when the order of exposure is *B-A-C* differ from those for the order *C-A-B* only in the position of the triangle with reference to the true position of the foreign body. Similarly, the movement of the body in the opposite direction produces merely a rotation of the triangle about the foreign body. To avoid unnecessary duplication of diagrams, these equivalent diagrams are omitted.

Fig. 3 represents conditions when the three exposures are made in the order

B-A-C, *i.e.*, with the tube in the central position for the first exposure, to the right of the operator in the second exposure, and to the left in the third. The upper figures are the result of displacements in the sagittal plane of the patient; those below, displacements in the nasotemporal direction. The left-hand figures assume a displacement between the second and third exposures; those on the right assume such movement occurring between the first and second exposures. A fifth diagram is added representing one of the possible combinations of motion along both of these components, *i.e.*, in an oblique direction.

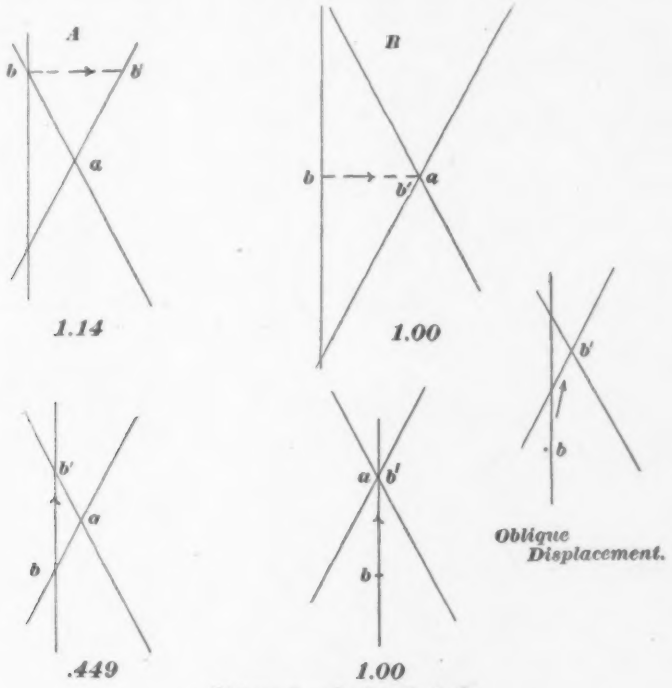

Figure 3. Order B-A-C

A critical examination of these diagrams will reveal that the true position of the foreign body may lie outside the triangle of reconstruction, that the area of the triangle varies widely and is not a true index of the degree of the error, and that a perfect "check" may result by the accurate intersection of the three lines of projection in a false position, with the result that not only is the error undiscovered, but the examiner assumes a dangerous confidence from an erroneous determination. The error $\frac{e}{d}$ ranges from 1.14 to zero, with an average of .897.

Fig. 4 is a similar arrangement of the diagram representing the order *A-B-C*. In this figure it will be seen that the area of the triangles is more nearly uniform and that the average value of $\frac{e}{d}$ is 0.84. Although no appearance of false accuracy appears by the intersection of all three lines in a common point, such an error is none the less possible, since the triangle will disappear if the displacement takes place in the direction of the proper line.

Fig. 5 gives the reconstructions for the representative cases where the order of exposure is *A-C-B*. In this group of figures we find the area of the triangles varying rather widely, the largest triangle representing zero error, and the average value of $\frac{e}{d}$ is 0.42.

The method just outlined is open to the serious objection that we have taken the averages of two points on a continu-

ous curve as representative of the whole curve. A fairer average may be reached by the analytical method given in a previous paragraph on the assumption that the displacement is equally liable in any direction from the correct position of the foreign body. This method applied to the problems just considered gives the values of $\frac{e}{d}$ as 0.903, 0.806, and 0.403, respectively, instead of 0.897, 0.84, and 0.42, as derived above.

The apex of the triangle has been selected for this graphic study, because it appears to us the better procedure. One might as well select some other point for the purpose of localization, *e.g.*, the acute angle at the base of the triangle. Here one is immediately confronted with the choice of two acute angles. The logical choice is the angle between the lines representing the first two exposures, since by so doing we immediately eliminate one-half the errors, *viz.*, those due to displacements occurring between the second and third exposures, at which time this point is already fixed. Or, one might select the point on the base-line equidistant from either acute angle, the "mid-base." These two points have been examined and the calculated results are here tabulated.

Fig.	Apex	Intersection.	Mid-base.
3	0.903	0.71	0.67
4	0.806	0.50	0.71
5	0.403	0.403	0.675

The lowest values occur under the conditions represented by Fig. 5, assuming the foreign body to lie at the apex of the triangle. Theoretically, then, it would seem that one should make the first exposure with the tube at one extremity of its carriage, then at the other end, and lastly in the median position, and should consider the foreign body to lie at the apex of the triangle of construction. The advantages of this method lie in a reduction

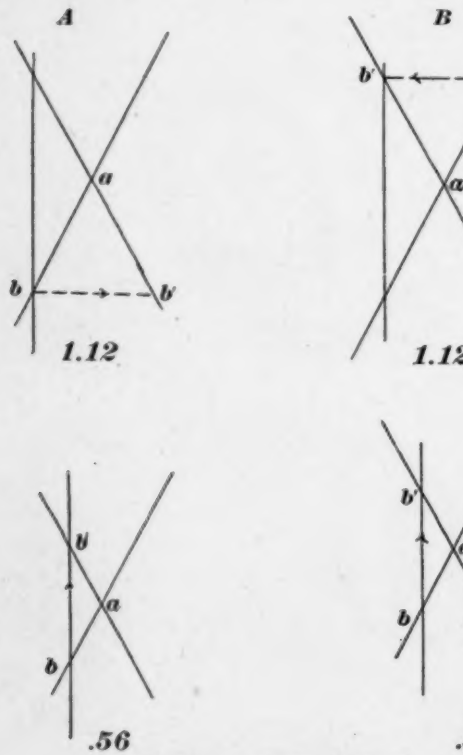

Figure 4. Order A-B-C

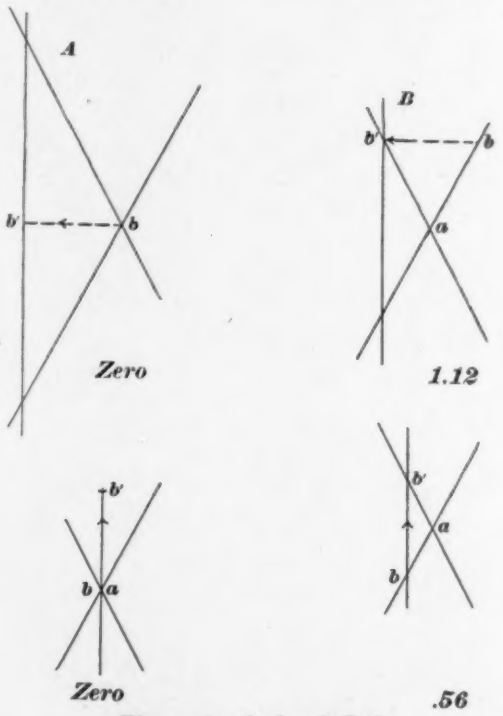

Figure 5. Order A-C-B

of the probable error from 71 per cent.[1] of the displacement to 40 per cent. of the displacement.

It occasionally happens that a case presents more than one foreign shadow for localization. By the two-exposure method multiple intersections result, allowing of more than one solution. Theoretically two foreign bodies allow of two solutions, three allow of six, while four present the choice of no less than twenty-four solutions. In any case one or more of these solutions may be absurd and the probably correct interpretation may be inferred. With a greater number than two the situation rapidly becomes hopeless.

The three exposure method, however, if correctly carried out, allows of a perfectly definite solution, no matter how large the number of the foreign bodies, from the fact that it requires the simultaneous intersection of three lines to determine the position of a shadow-producing object. If the purely accidental and highly improbable intersection of three lines at a point which does not represent the position of a foreign body should occur, the remainder of the solution would immediately declare the falsity of this point by satisfying all the conditions of the problem without it.

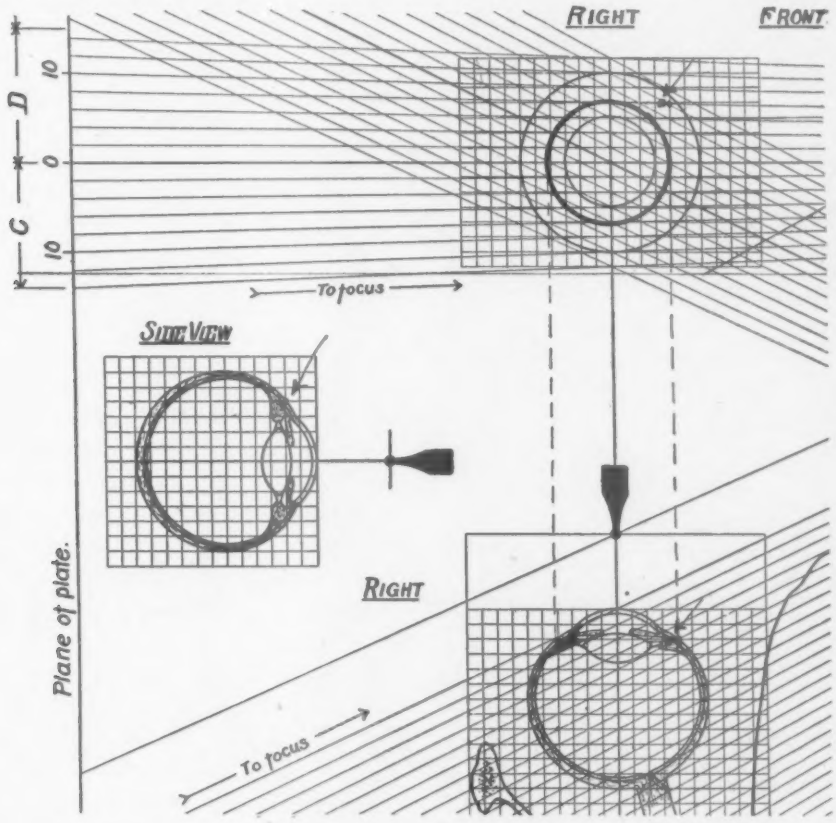

Figure 6

The same considerations apply to the localization and the determination of the direction of the axis of a linear body by means of the position of its extremities. Only one solution is possible and that is the correct one.

Occasionally it may happen that the position of a foreign body is such that its shadow falls outside of the window pro-

[1] Since the opportunity for error is only one-half as great where there are but two exposures and but one interval as when there are three exposures and two intervals, the value of 1.42 previously found must be halved to give a correct ratio.

vided by Dr. Sweet, and the shadow does not appear in one of the exposures. This actually happened in the very first case in which we used the method. Localization was still possible, and quite as accurately as by the usual method, because it showed clearly in the other two exposures, and we were spared the humiliation of being obliged to report that we could demonstrate the foreign body but not determine its position.

We can see no serious objection to this modification of Dr. Sweet's excellent method. If the shadow is lost in that of the dense temporal bone, we are in no worse case than we should be with two exposures, since localization is still possible; with reasonable care there is no danger to the patient; and it costs no more to make the third exposure on the same plate. On the other hand, it places the operator in the position to prove up on the technical end of the work, to demonstrate the adequate fixation of the eye, or the lack of it, and in the latter case allows of a fair approximation to the truth in case of necessity. It further provides a definite solution in cases of multiple foreign bodies and in cases of unusual positions in and about the eye within the orbit.

Out of these considerations, we recommend the routine making of three exposures and in this order: the tube in the caudad position for the first, the cephalad position for the second, and the median position for the last.

We have preferred to use a harder ray for the cephalad position rather than a longer exposure with a softer ray, to insure against possible damage to the patient if repeated examinations should become necessary. This adjustment of penetration is easily and instantly made with a Coolidge tube and introduces no complications.

Occasionally it may be difficult to tell whether a body located within the limits of the inscribed diagrammatic eye really lies within the eyeball.

We may assume a foreign body giving the following coördinates: *B*-12, *D*-8, and *E*-8. Its position will be determined as shown in the chart (Fig. 6). In each view it falls within the outline of the globe. Still it lies outside the globe.

If we will inscribe on the front view of the eye a circle with a radius equal to the distance of the outer surface of the sclera at the level of the foreign body as measured on the horizontal section, we will see that the body lies outside of this circle. Yet this circle represents the line of section of a plane normal to the optical axis and passing through the foreign body and therefore the outer limits of the eyeball. If the shadow lies outside the circle in that plane, it must lie outside the eye.

Similarly, the position with reference to any of the annular structures of the eye may be delimited by a circle of proper radius, *e.g.*, the lens, ciliary body, etc. This, of course, presumes that the diagram correctly represents the size and shape of the eye.

I wish to express my appreciation of the hearty coöperation of Dr. Walter R. Parker and the staff of the Department of Ophthalmology.

SURGERY OF X-RAY LESIONS *

LEWIS L. MC ARTHUR, M.D.

CHICAGO, ILL.

IN one of those weak moments that come to most of us when flattered I agreed to address you on "The Surgery of *X*-Ray Lesions." The fact that I have lived through the entire period of its history from the very first demonstration in this country of its applicability to medicine and surgery to the present day and that I had been indirectly instrumental in causing the first as well as the most extensive *x*-ray burn ever known, may qualify me to some extent in addressing you on this subject. I had seen and operated upon more cases than can reasonably be expected in the future to be seen by any one in these days of accurate dosage and well controlled interval between exposures; but, oddly enough, since agreeing to address you I have had four cases of roentgen burns to operate upon and one of the acute type requiring early future interference, which I am fortunately enabled to present for your inspection.

Any consideration of the surgery of roentgen lesions naturally leads to a subdivision of the subject into a grouping for convenience something as follows:

(1) Roentgen keratoses

(2) Acute burns (2nd and 3rd degree)

(3) Chronic inveterate burns (white gangrene)

(4) Carcinoma developing in cicatrices or keratoses.

ROENTGEN KERATOSES

Roentgen keratoses, which are probably most frequently seen at your reunions, and on your own hands, have been a source of the greatest astonishment to me, because of the apparent utter indifference with which you regard them. To me, having been obliged to amputate fingers, hands, forearms or arms of expert roentgenologists, for a trouble having its inception in so simple and so chronic a lesion, they present a most sinister aspect.

Let me here digress a moment to refer to the most brilliant bit of *a priori* reasoning in medicine with which it has ever been my good fortune to come in immediate personal contact. One of the very early lesions following in the wake of healed roentgen dermatoses was the hardened wart-like keratosis. Having made a careful study of the histological structure of these bodies and recognizing in them the conditions corresponding to the common senile keratoses, Dr. W. A. Pusey in an address delivered before the New York Dermatological Society spoke about as follows: "Gentlemen, after a careful study of these keratoses, which are almost identical histologically with the senile keratoses of the aged, I venture to predict that you will sooner or later meet with the corresponding epitheliomatous degenerations which are observed in the senile form." This nearly two years before the first reported carcinomatous development in a roentgen lesion! How frequent, nay how sure, this sequence now is, we have but too slowly learned.

More because of the annoyance and discomfort than because of this fear, I early had occasion to remove these keratoses, substituting for them a Thiersch graft. This is an easy, safe and almost universally successful procedure, and in my experience has resulted in a cure of the lesion, comfort and protection for the future. The technic is very simple, being accomplished in most situations by a horizontal amputation with a razor to such a depth that there still remains a portion of corium. On this surface is laid a single Thiersch graft which a little practice enables one to cut of corresponding size. Where feasible, no dressing at all is applied, the area

* Read before the Chicago Roentgen Society, March 9, 1917.

being protected from friction or contact by a vaccination shield or corn plaster. Otherwise a dry surgical dressing of exactly the same size is applied and held in place with adhesive strips. In the light of our present knowledge no roentgen keratosis of any size should be neglected until epithelioma develops. It should be promptly removed and the site grafted.

The first Chicago victim to succumb, Mr. Fuchs, was the photographer engaged by Dr. Otto Schmidt to develop his roentgenograms. During the many visits I made to him for early roentgenological work, I noted the roughened, fissured, warty condition of his hands and pleaded with him to do or let me do something for them; but he was so convinced it was due to the developing fluids and not to the ray that he did not recognize his mistake until it was too late. After having lost two or three fingers by amputation he came to me only when an immense fluctuating tumor in the axilla developed. The armpit had not been cleared at the time of the finger amputations! The attempt to remove this fluctuating mass revealed the very constant and peculiar characteristic of the neglected lymph gland of roentgen ray carcinoma. It resembles greatly the content of certain dermoids, being an enormous collection of large epithelioid elements, seen through the microscope to be undergoing a fatty degeneration. In his case it is no exaggeration to state that at least four ounces of this material came from one of the larger axillary glands.

The axiom then in roentgen ray carcinoma consists, as in ordinary carcinoma, in the early removal of the lymph nodes, exercise of a police vigilance over the affected area and, in the case of the hands, a careful watch of the epitrochlear glands. When these roentgen keratoses, even while very small, have begun to assume a suspicious change, and on removal have proved microscopically to have just begun to undergo an epitheliomatous change, I have after a removal of the phalanges and the sheaths of the tendons down to the periosteum successfully preserved the finger or thumb by burying it beneath an appropriate abdominal skin flap, with conservation of the entire usefulness of a surgeon's hand.

ACUTE BURNS

I have chosen to apply this term to those burns which are now largely seen as the result of the use of the rays for therapeutic purposes, such as the treatment of lupus, a superficial carcinoma cutis, or an eczema hiemalis. In these cases we occasionally meet with the more or less complete destruction of the skin presenting a peculiar grayish white diphtheroid ulcer with moist surface, which will persist in these characteristics in spite of any and every local application, and continue to be most exquisitely sensitive or painful. Experience having taught the obstinate chronicity of these lesions, has led to their being referred by the dermatologist to the surgeon.

When of very moderate size and so situated that the cosmetic appearance is not important, the "white" gangrenous area can be excised, the skin edges undermined for mobilizing, and the wound closed per primam. When this is not practicable, instead of drawing the skin together with sutures, a large well-fitting Thiersch graft will often do the work. One caution should be always borne in mind. If the excised burn be surrounded by skin of markedly impaired vitality sutures in such skin will cut out with incredible ease. Therefore, no burned area should be covered by transposed skin flaps whose integrity has been lowered by the ray, if decided tension on the sutures is necessary to hold them in place. Such an error of judgment was made by me in a case that left the hospital two weeks ago. In this patient the presence of stones in the left kidney had been demonstrated some months previously. While seeking escape from cold winter weather by a trip to ———, she consulted some medical men in ———. In order to determine whether the stones had been passed, or retained above in the kidney, three unsuccessful attempts in one day

were made to photograph them. Following this there ensued a third degree burn of the abdominal wall with the umbilicus as the center. After three weeks' treatment she came north and was referred to me. I excised the area (about three by two inches) down to the external sheath of recti, undermined the skin to a distance of three or more inches above and below the site, so mobilizing the flaps that they came well together but nevertheless under some slight tension. Their vitality, however, was lower than I had estimated. The stitches promptly cut out, leaving a transversely gaping wound, with the edges of the skin showing more of the peculiar white gangrene. Ordinary gangrene of the skin separates from the living in about nine days; in this variety it never separates, having just enough vascularity to keep it alive. A second operation was therefore necessary to remove tissue which should have been removed at the first sitting. In the majority of cases I would therefore advise excision of the "white gangrene" with immediate Thiersch graft, and shall so advise in the case herewith exhibited.

CHRONIC X-RAY ULCER

In the earlier history of roentgenology quite a number of ulcers came to the surgeon which had for weeks and months resisted all topical efforts to heal them. Since it was my misfortune to be in part responsible for the causation of the first, largest, and most severe burn in the history of roentgenology, you will pardon me if I devote some time to a résumé of its history.

Capt. J. McA. W., of the U. S. Army, received a bullet wound with entrance in the lower lumbosacral region; no wound of exit. This so lamed his right lower extremity that he feared retirement from the service a year later. He consulted me in the fall of 1898, presenting symptoms which led me to suspect injury of the cauda equina, or lumbar plexus. Dr. Archibald Church, studying the case with me, determined that the lesion involved the muscles supplied by the anterior crural nerve, and suggested that an effort be made to locate the bullet by the roentgen ray. Dr. Otto Schmidt had just installed the first roentgenological laboratory in Chicago and the United States, and accordingly Captain W. was taken there. Three exposures were made the first day of ten, twenty and thirty minutes, but without results. On the second and third days the exposures were similarly doubled until, as was estimated months later, there had been over seven hours' exposure in three days! And no bullet shadow! The captain's leave of absence having expired, he returned to Fort ———. At the end of a week the well-known sequelæ of roentgen burns began to show, consisting in redness, itching, watery discharge, gangrene of the skin, intolerable pain and tenderness. The surgeon at the fort did everything possible to relieve his suffering, but in vain. After two months I urged him to return to Chicago. On admission to the hospital there existed a dull gray gangrenous area extending from the transverse nipple line to within an inch of the symphysis. Above and below this area roentgen dermatitis with telangiectases was present from the under surface of the chin, from which the beard had fallen out, to the symphysis, and likewise laterally. Realizing that the task would be hopeless by medication I excised an oblong area of ten by four inches. I was surprised and mystified to find that this "white gangrene" could not be touched with the sharp spoon, but required actual dissection with the scalpel. In cutting, it was of almost cartilaginous hardness and required dissection down to the surface of the intercostal muscles with the removal of portions of the sheaths of the recti muscles! Two-thirds of the burn being abdominal, I undermined the skin well past the posterior axillary line on each side and was enabled to suture in the midline. The same procedure not being practicable over the upper third of the burn because of the unyielding background of ribs, I depended upon

Thiersch grafts. These, however, were not wholly successful, a small midsternal area requiring eighteen months to heal. Picture my feelings during all this siege!

Hear now the subsequent history. Retired from the army, he secured appointment in the Indian Reservation Agency service in Idaho. For *eleven years* he enjoyed good health with no trouble in the scar. At the end of that time there began to be some tenderness, proliferation and enlargement in the scar in the region of the umbilicus. Seeking aid, he was informed that a cancerous change was taking place. Again he returned to Chicago and to my care. Microscopic examination confirming the diagnosis he was advised to have the growth removed. On operation, in 1908, an oval excision of the linear scar was made, involving the entire thickness of the abdominal wall, skin, fat, mid-half of both recti and peritoneum, thus exposing the abdominal contents. Handley's researches having just demonstrated that it was through the lymph channels in the round ligament of the liver that recurrence from breast carcinoma so frequently takes place in the liver, that portion of it attached to the umbilical site was simultaneously removed. Heavy through and through silk tension stitches, closely posed, enabled me to draw the rather flabby abdominal walls together and secure primary union, at the same time converting the major's waist line into that of a lieutenant!

Eight years have now elapsed and I am gratified to report that the patient continues in perfect health.

CARCINOMA DEVELOPING IN CICATRICES OR KERATOSES

Carcinoma, then, is the ultimate danger which besets every individual who has once been severely burned by the roentgen ray. It invariably is of the squamous celled type, and is peculiarly prompt in involving the lymph glands. This is especially true of those small indolent ulcers of the hands so sure to take on a mixed infection with some of the inflammatory organisms to which they are constantly exposed. Under these conditions, they are carried along with the leucocytes up neighboring lymph channels to be arrested at the nearest lymph node. I have twice met this in the epitrochlear glands at the elbow. During the past month Dr. Glidden, of Danville, died after a fight of over ten years for his life. I early removed his keratoses and substituted skin grafts; after some years other areas became carcinomatous and I removed the index finger as well as the axillary glands. Later, other portions of the hand became involved and part of the hand was resected by Kanavel. Amputation of the forearm followed and finally an amputation of the remaining part of the arm at the shoulder by the Mayos. The axilla was reported free. The case ended with pulmonary involvement and death.

Six weeks ago I amputated a finger for a minute superficial roentgen ray carcinoma, on which three weeks before I had placed a Thiersch graft after dissection down to the tendon sheath. The portion removed was pronounced epithelioma. The graft took nicely, but three weeks afterwards broke down centrally into a suspicious ulcer. The finger was then amputated. Microscopic examination of the finger showed a necrotic area at the site of graft, but no epithelioma. This finger, like those of a second case I operated upon, had been sacrificed as a result of therapeutic treatment of eczema hiemalis. The patient thinking that, if roentgen treatment was good, the nearer he put his hand to the light the better, and when the roentgenologist's attention was attracted elsewhere, he would raise his hands nearer the tube. While this completely exonerated the physician, the lesson should be learned and treasured: watch your patient!

ABDOMINAL TUBERCULOSIS

BY PAUL EISEN, M.D.

CHICAGO, ILL.

ABDOMINAL tuberculosis, as we see it roentgenoscopically, not only excludes retroperitoneal and therefore also urinary tuberculosis, but also tuberculosis of the large abdominal glandular organs, pancreas, liver, and spleen, as well as of the genital organs in women and of the omentum, because with present methods these organs cannot be roentgenologically visualized. Nor are tuberculous calcified glands being considered. The gastrointestinal tract is at present at least the large field where abdominal tuberculosis is recognizable. Even so, the tuberculous nature of the diseased portion is not definitely recognized as such roentgenoscopically, but can be only suspected of being tuberculous. However, the changes occurring in tuberculosis of the gastrointestinal tract are, to a certain degree at least, quite characteristic, although the same changes may occur from another source. This does not include tuberculous strictures, because they are not roentgenoscopically characteristic of tuberculosis, but by keeping the possibility of the tuberculous nature of the changes in mind, other means are at hand to either prove or disprove such assumption to a certain degree.

The selection of one case out of a series of six which were operated upon at the North Chicago Hospital will serve to illustrate the characteristic roentgenoscopic changes. This case, with two others, was not recognized as tuberculous, while the other three were. Up to that time the only available information on the subject were an article by Stierlin on the recognition of ileocecal tuberculosis and the description of a case of tuberculosis of the stomach presented by J. T. Case. In both instances a filling defect or spacing was the most prominent feature. In another communication on ulcerative colitis, Stierlin called attention to the spotted marble-like appearance, especially of the descending colon. He did not, however, state that this also occurs in ulcerative colitis of a tuberculous nature. Syphilis of the descending colon would probably give the same appearance. Typhoid fever has not been subjected to a roentgen ray examination to my knowledge.

The most characteristic phenomena in my experience of tuberculous enterocolitis are the constipation, as found clinically, and the roentgenoscopic appearance of diarrhea. As soon as the barium meal has completely left the stomach, it is quickly distributed over the whole bowel from the jejunum to the rectum. This is so remarkable a feature in the case as to immediately suggest diarrhea. Instead, there is constipation.

Stierlin's observation to the effect that the tuberculous part of the bowel is found empty roentgenoscopically was confirmed in the one case I have selected for consideration, but this does not nearly apply to all cases. In fact, many cases would escape detection entirely, if this sign alone were to be relied upon.

Another characteristic feature in gastrointestinal tuberculosis is the fixed appearance of large stretches of the bowel and their conglomeration and permanent localization in given parts of the abdomen. Thus, in the case under discussion the ileocecum was in the right hypochondrium, which made us suspect adhesions from gallbladder trouble, especially as the pancreas was clinically involved (sugar in the urine).

Another, although less characteristic finding was the localization of pain over areas of bowels that were empty, a finding we see in acute appendicitis and acute duodenal ulcer. It is only a few days ago that I made this observation in an old lady of 75, who had a tumor presenting at the cecum. On opening the abdomen, an ab-

scess around a perforated appendix was found, and neither by meal nor enema could the cecum be visualized.[1] A similar picture is seen in cancer of the cecum, and is more characteristic still in the hyperplastic form of ileocecal tuberculosis. As mentioned before, I do not care to discuss strictures of a tuberculous nature causing obstruction. Neither will I enter upon the changes occurring from tuberculous ulcers, because I have not been able to recognize their localization previous to operation. However, I see no reason why they should not cause changes similar to those seen in gastric and duodenal ulcers, changes due to permanent segmentation opposite the ulcer. Plates alone will be able to disclose their situation.

The reason why we failed to recognize the tuberculous nature of this case is that we never considered such a contingency. The appendix alone, in the ileocecal region, was visible. It was immovable and painful on manipulation. We naturally suspected its involvement, and our conclusion was borne out by the facts, but the tuberculous nature of the lesion was first established at the operation.

In all our cases of abdominal tuberculosis the lungs appeared perfectly clear even in stereoscopic roentgenograms. The patients, however, were of youthful age, ranging between 19 and 33 years. The abdomen was generally too rigid to admit of careful palpation. Good stereoscopic plates are of the greatest value. Of the three slides I am presenting one was taken previous to the operation, while the other two were taken subsequently. The spacing referred to by Stierlin is a prominent feature in this case, but the uneven distribution of the meal is, in my experience, more characteristic. I hope to hear other opinions to-night, so that we can carry home with us a more concise picture of what we may expect to see in abdominal tuberculosis.

The examination, as communicated in detail by Dr. Leopold Frankel, resulted in a diagnosis of subacute appendicitis with a possibility of gallbladder affection.

[1] Later, at resection, the tumor proved to be cancer, originating in the appendix.

DENTAL PATHOLOGY: ITS IMPORTANCE AS AN AVENUE OF INFECTION

ROENTGENOGRAPHIC FINDINGS*

BY FLOYD D. LEACH, D.D.S.

CHICAGO, ILL.

A PAPER of this character must necessarily eliminate the conditions due to diseases of the enamel or dentine, and confine itself to an explanation of the lesions of the dental pulp and the soft and hard structures which invest or immediately surround and support the teeth themselves. Furthermore, in order to make a subject covering this field properly illuminative, it must be followed by a lantern slide demonstration of the various conditions in hand conforming in the interpretation of the same as near as possible to the order in which the points were brought out in the paper.

The dental roentgenogram has been the agent which has supplied us with the bulk of this information and can be considered as at least fifty per cent. efficient in diagnosis, providing that it is backed by a good knowledge of dental anatomy, histology, physiology, pathology and nomenclature, together with a proper history and thorough understanding of the clinical findings in the case presenting.

Without wishing to be considered too critical on the one hand, or over-conservative or ultra-radical on the other, I do know that many teeth are being condemned and sacrificed upon the showing of the roent-

* Read before the Chicago Roentgen Society, November 17, 1916.

genogram alone, while many teeth are retained in the mouth which should be removed, simply because some one has interpreted a good roentgenogram improperly or read too much into a poorly made film.

Faulty diagnoses are not tolerated in the courts, and the professions must educate themselves as well as their clientele to a higher standard of this work and remove it from the commercial field.

Chronic dental lesions arise from either trauma or infections of the soft tissues of the teeth and their supporting structures, and the etiology may be ascribed to the invasion of certain bacteria which gain ingress by way of three avenues: (1) the pathologic pulp or infected or over-medicated pulp canal; (2) along the space provided for the peridental membrane and the unhealthy membrane itself; (3) directly from the blood stream as it passes through and about these areas of lowered resistance.

About this latter type nothing of great certainty is known and the idea is considered by many as theoretical, but for my own part I do not see why it would not apply as well in the soft dental structures as it does to other portions of the anatomy, especially since it has been shown that both the pulp and peridental membrane contain minute and delicate lymphatic accessories.

Let us take up first those disturbances arising from an infection of the pulp canal and gaining access to that tiny space at and just surrounding the end of the tooth root. This little area is known as the apical space and acts as a slack wire adjunct through which pass the nerves and blood vessels supplying the pulp; also, some few fibres of the peridental membrane which, although very minute, are to a certain extent a protection, but delicate and without resistive properties and lacking in the powers of rebuilding once they are destroyed either by infection or over-medication.

It is nearly safe to state that at least ninety per cent. of the root canals treated, and attempts made to fill these canals, have been followed by a destruction of the tissues of the apical space, either by infection or irritation due to the over-use of drugs and root-filling materials.

It has been the custom of some practitioners in the past, and is still advocated by many to-day, that it is perfectly good practice to use arsenic in the destruction of pulps of teeth and in severe chronic and putrescent cases to force phenol, iodine and other escharotics and irritating drugs through the root canal and into the apical space; also, the carrying of root-filling material into this space with the hope that the end of the root will be encapsulated, that the surrounding tissues will take kindly to the foreign body and obliterate the space by building in around it. These procedures may work out fairly well in twenty-five per cent. of the cases of one certain technician, but how about the other seventy-five per cent., and how about the cases handled by those who are unskilled in this particular branch of dental work, or those who give it no thought whatsoever? The practice is pernicious and should be discouraged by the medical profession. The word of the medical man carries with it great weight and I think much good could be wrought for the people at large, if the members of these societies would help enlighten and educate their following along this line, together with their associate dentists.

These infections at the ends of roots take some of the following forms: An acute inflammation of the tissues of the apical space with an elongation of the tooth which is painful, especially to pressure upon the tooth laterally or toward the end of the root, going on to the acute alveolar abscess with a certain amount of destruction of tissue, both hard and soft. The pus then burrows along lines of least resistance and finally perforates the buccal or lingual plate of compact bone, reaching the attachment of the periosteum which is cut to a certain extent. This stage is accompanied by much pain and more or less elevation of the periosteum. A successful lancing at this point will be very

beneficial to the patient, but, if unattended, it will rupture into the soft overlying tissues and most of the pain will subside. As a general rule extensive swelling of the surrounding area results until a fistula is formed, and thus there develops the chronic stage, making itself manifest only as a small "gum boil," which is generally regarded by many as inconsequential and only Nature's way of getting rid of the pus, while in reality it is very dangerous to the general health of the individual.

The roentgenographic reading in a chronic case of this kind is that of a heavy, dark shadow, generally circular in form, about the end of the root.

The next form of alveolar disturbance due to root ends is one without a fistula and which has never perforated the plates of compact bone. This shows as a dark shadow but somewhat lighter than in the preceding case, and may be definitely circular in shape or assume a very irregular outline, depending upon the structure of the bone in which it lies. In most cases of this kind the bone is of a carious nature and has been destroyed progressively in layers and cell by cell. If the area is very extensive, it may be possible to discover a number of very minute openings. A sharp steel probe passes readily and with little pain into the mass, and the tooth root can be easily distinguished from the surrounding dead bone. This type of lesion is very vicious, as the pus is generally under more or less pressure, so that the active microörganisms and their toxins are very easily absorbed and carried into the blood stream.

The last form of root end trouble, and one which I believe to be as insidious as any dental lesion, is one which appears in the roentgenogram as a very small but well-defined shadow just about the apex of the root, which might be misinterpreted as an enlarged apical space. It is generally a granulomatous wall within which there may or may not have been bacteria at work over a long period. The toxins from these microörganisms have more than likely been slowly seeping through this protecting wall for many years, entering the blood stream and spreading throughout the general system. Some dentists consider this tiny area not worthy of note, and again tell the patient that this is Nature's way of protecting him from the invasion of bacteria. But how about the toxins? Most assuredly, if there are live bacteria in this area (and in many cases they can be secured and grown on culture), they must be giving off waste products, and certainly said microörganisms cannot live upon their own toxins. I claim that these very small and insignificant areas should be looked upon with as much suspicion as those of larger dimensions. It is not so much the number of bacteria present which causes the greatest amount of harm in any particular case as their efficiency, when virulence is considered. One match may cause any number of tons of gunpowder to explode, when properly applied.

The roentgenographic findings in cases of so-called pyorrhea alveolaris are nearly self-explanatory. These pockets along the roots of teeth can be traced back to either a malocclusion or some form of a traumatic injury to the teeth themselves, or their investing tissues.

Loss of contact between teeth in the same arch, faulty occlusion of bridges and crowns, cavities, fillings, crown bands and orthodontic appliances, together with a misguided manipulation of the tooth brush and abrasive pastes and powders, or the administration of some form of mercury: all have at some time been considered causative factors in these lesions. Serumal and calcareous deposits along and under the gum margins are also a cause.

These destructions show very clearly in the dental negative, and I can only state, as Dr. Logan has so aptly summed up the situation, "that when the pocket has reached the junction of the gingival and middle thirds of the root, even under the best of treatment, the prognosis for that tooth is many times doubtful, and when the destruction has gone to the middle third, better extract the tooth."

As to these root end infections, especially if the patient is ill with some general systemic disturbance, Dr. Gilmer says: "When these root ends are denuded they must be eliminated, either by root end resection in some favorable cases, or by the extraction of the tooth."

In the meantime, the dentist himself has been so interested in retaining the tooth in the mouth for incising, tearing, crushing and mastication purposes, that he has forgotten the patient entirely.

The burden of this paper really is to interest the members of this Society in a little missionary effort on your part among the dentists with whom you come in contact, so that they will carry out your orders properly when you ask that a patient's mouth be examined and placed in a condition which will not be a continual source of infection to the host.

The public at large as well as the dentist must be guided aright as to these things dental, and if the whip has to be applied I can see no better administrators than the vast body of medical men.

A RENAL CALCULUS OF UNUSUAL SIZE

BY E. H. KESSLER, M.D.

ST. LOUIS, MO.

RECENT literature has contained a number of references to giant renal calculus. The following case is reported because of several points of unusual interest:

The roentgenogram was made and the stone discovered while catheters were in place at the time of a renal efficiency test. No injections of any kind were made. The shadow is all representative of stone. The patient was never sick until about four years ago, when he fell, injuring his back, as he expressed it. This injury kept him in the hospital about six weeks. According to the patient's reports, there were no abnormal urinary findings at that time. His stay in the hospital was prolonged on account of the pain in his back. From this injury he apparently made a complete recovery and was free from complaint until about six weeks before the accompanying roentgenogram was made. At that time backache was the most prominent symptom. The urine began to show cloudiness, temperature and headaches were manifest, but at no time were the symptoms sufficiently severe to put him to bed.

FIG. 1.

On June 30, 1916, the patient was referred to me and I examined the urinary tract. The outline of the right kidney could not be shown. The plate of the left renal region showed the same large shadow seen in the accompanying illustration. On July 1st, Dr. Lund introduced catheters into the ureters in connection with a test of renal function. He found no urine coming from the right side. The left kidney,

the one showing the large shadow, was apparently the only one functioning. Pus and blood were present. The roentgenogram was made while the catheters were in the ureters as described.

The patient was not operated upon for two reasons: first, there were no urgent symptoms; second, the damaged kidney was the only one that was secreting.

The patient was seen six months afterwards, in fairly good health, pursuing his usual vocation of teaching.

On February 6, 1917, patient developed a high temperature with great pain in the right kidney region. An operation was immediately performed and about 700 c.c. of pus were evacuated from the right kidney. The kidney was not removed in the hope that it might regenerate sufficiently to help its fellow with the large calculi.

The patient's progress was reported as satisfactory and on March 1st he left the hospital.

"QUIET" POTT'S DISEASE

BY WILLIAM A. EVANS, M.D.

DETROIT, MICH.

BABY V., age four and a half years, referred by Dr. Frederick C. Kidner for examination of the lower spine.

History: Family history negative for tuberculosis. Personal history: Always well. Eighteen months ago she suffered a fall, after which she complained of pain for several days in her lower back. She fully recovered from this injury, and not until a year later did she present any symptoms. At this time, a small lump appeared in the lower lumbar region, and this increased gradually to the present time. The only known symptoms were occasional slight pains in the left leg, and these appearing only when the child was tired.

The case is presented on account of the marked changes which can occur in the lower spine without impairment of the general health. The destruction of the body of the fourth lumbar, with involvement of the contiguous portions of the third and fifth are well shown on the lateral plate. We would call attention to the outline of the prevertebral abscess which can be seen in both the anteroposterior and lateral views.

FIG. 1. "QUIET" POTT'S DISEASE, ANTEROPOSTERIOR PLATE.

Showing a disturbance of the third, fourth and fifth lumbar segments, and the outlines of the prevertebral abscess as indicated by the arrows.

FIG. 2. "QUIET" POTT'S DISEASE, LATERAL PLATE.

Showing a disturbance of the third, fourth and fifth lumbar segments, and the outlines of the prevertebral abscess as indicated by the arrows.

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EDITORIALS

THE NEW YORK MEETING

The success of the eighteenth annual session of the society under the able administration of Major Lewis Gregory Cole was an encouraging example of American steadiness under war conditions. Although military duty made it impossible for many members to attend and many of the old guard, such as Case, Hickey, Pirie and Brown are somewhere in France, yet notwithstanding this heavy handicap, the momentum of scientific endeavor has not been lost.

The printed program was not of a military character but the discussions, the impromptu addresses, the manufacturers' exhibits and the appearance of most of the members in uniform showed that after all the supreme interest of the society was in the world struggle. The presidency passed out of the hands of one major into the hands of another. With a major as secretary and with most of the remaining officers already in the service, the society has in truth entrusted its next meeting to the fortunes of war.

The wisdom and efficiency of Major Christie, the Chief of the Department of Roentgenology, was seen in such appointments as Major Shearer to head the American School of Military Roentgenology, and Captain Case to head the American Roentgenological Service in France. This order removed. Captain Case from the Ambulance Corps which he had organized with characteristic promptitude and which demonstrated his patriotic willingness to serve his country in any capacity however humble.

The manufacturers' exhibit is always one of the valuable features of the annual sessions. It was managed this year with unusual success. This exhibit included apparatus especially designed for military service. Exhibited apparatus showed the same extraordinary adaptation of means to ends which has made American inventive genius in other lines also without a peer.

Major Shearer and Major Johnston described to the society the evolution of the present field apparatus from the bulkiness and complexity of the usual hospital equipment, to lightness, simplicity and increased efficiency. In all this work the officials have had a whole-hearted patriotic coöperation from high and low, from the

wonderful genius of a Coolidge to the intelligent skill of the man at the bench.

It is easy to predict that after the war, hospital and office equipment will undergo many changes as a result of military example, and that country districts remote from stationary current supply will have the advantages of the military system. But we must remember that the qualities of the roentgenographic field unit which so admirably adapt it to the requirements of military service have been in part attained by eliminating the capacity for instantaneous plate exposures so essential in chest and gastro-intestinal work. The fact that the mobile field unit is not expected to do all the necessary military work in roentgenology was forcibly illustrated by the interesting communication of Major LeWald, detailing the experiment of making chest plates of one hundred recruits who had undergone physical examination by expert internists. We hope to present this work later in the JOURNAL.

The immense field for statistical study which is opening because of the records of physical examination of all conscripted males in the United States between the ages of 21 and 31, will be greatly enriched by the routine use of the roentgenographic plate. It is doubtful if the opportunity on so huge a scale will ever again arise.

But the energies of the society must not be wholly absorbed in military work. The lamp of pure science must be kept burning. In Europe the state of mind necessary for fruitful research cannot be recovered, in all probability, during this generation. Moreover, thousands of men who might have been of inestimable value in the advancement of science rest in nameless graves—a priceless sacrifice of both friend and foe. An unwritten obligation rests upon us who remain. The past achievements of American science and American roentgenology give us courage to believe in all humility but with the vigor of an awakened people that we will fight a winning battle for light and knowledge.

A. W. C.

SCHOOLS FOR MILITARY ROENTGENOLOGY

Whatever lack of enthusiasm may have prevailed in regard to the appreciation of the courses in roentgenology, provided for military reserve officers, at the time of their inception, seems to have been entirely dissipated after these schools had been in operation for a few weeks. There is no doubt that some medical reserve officers who may have been considered roentgenologists by many friends and colleagues and in some instances admitted by brother roentgenologists to have definite qualifications may have felt some hesitancy in attending a school for roentgenology. But a few weeks of review and concentration upon certain phases of the military application of the art brings every conscientious medical officer to a realization of the fine method and foresight displayed by the Surgeon General's Office in backing up this proposition, as originally planned by the Preparedness Committee of the American Roentgen Ray Society.

The whole proposition is as fine a piece of preparedness as anything done in any other department of the government. Upon paper and by personal admission there may be many brilliant roentgenologists who would make poor military *x*-ray men. There is great need for standardization of technic, apparatus, position, supplies, records, localization, etc. Furthermore, the American roentgenologist has been notoriously dependent upon the manufacturer's agent when anything went wrong with the apparatus or even with the exposure technic. These schools will attempt to place the military *x*-ray man upon his own feet and instil into him enough primitive electrical knowledge to permit him a certain independence when he is confronted with apparatus troubles in the field, where the manufacturer's technician is not at the other end of the telephone.

The review of the various roentgen activities in medicine and surgery which these schools demand is valuable to the man who may have unconsciously discov-

ered that his roentgenological work was confined to certain channels—and perhaps these channels not useful in a military way. For instance, gastro-intestinal roentgenology will not be extremely useful, while examinations for tuberculosis, faulty teeth and fractures may be extremely necessary, not to mention localization of foreign bodies in the eye and other parts of the body.

Speaking of localization of foreign bodies, have you ever stopped to consider the methods *ad infinitum* which have been proposed with that object in view? It is a notorious fact in medicine that, where there are many treatments proposed, it is because no single one is satisfactory for the treatment of the condition. Again, while a roentgenologist may have a method which gives him a definite idea of the anatomical localization of a bullet, it will frequently be found that such a localization is not of value to the surgeon for an operative removal of the bullet. The transfer of the localization from the roentgenologist to the surgeon is a delicate and difficult problem. This is one very good reason why it is best for the localization to be made by a physician-roentgenologist rather than a technician. The team work of the surgeon and his roentgenologist will be most advantageous.

Fluoroscopic surgery has become a great factor in successful bullet extraction in France and is attested to by Thurston-Holland in his recent presidential address before the British Roentgen Society.

This is not the time nor place to mention the names of roentgenologists who have been responsible for this seemingly successful experiment in military roentgen schools, but we may not hesitate in congratulating the American Roentgen Ray Society on possessing a President and a Secretary who have measured up to and beyond the task presented to them by the National Medical Council of Defense.

Furthermore, it is a fortuitous circumstance that Surgeon General Gorgas recognized the importance of securing specially trained roentgenologists and that he found such efficient counsellors and advisors as Major A. C. Christie and other medical corps officers within his own staff.

E. H. S.

We hope in the succeeding issues of the JOURNAL to print articles, letters, and reports from "The Front." With the present editor, Captain Case, and the former editor, Major Hickey, both in France, we are confident that readers of the JOURNAL will have the fullest and freshest roentgenologic news from the active theater of war which the censor will allow to pass.

It has been suggested in years past that the bond of good fellowship which distinguishes this society was due in part to the common dangers to which all were exposed. The annual banquet demonstrated that the coming hazards of war have already forged new and stronger bonds, especially between those who wear the khaki. Let those of us who stay be glad that this is one of the compensations for the heavy sacrifices which the war entails.

TRANSLATIONS & ABSTRACTS

KEENE, FLOYD E. Value and Limitation of Radiotherapy in Gynecology. (*Jour. Am. Med. Assn.*, Oct. 28, 1916, Vol. LXVII, p. 1328.) (Read before 66th Annual Meeting of Med. Soc. of the State of Pennsylvania, Scranton, Pa., Sept., 1916.)

Keene analyzed 116 cases. Sixty-nine cases were of malignant growths of the vagina, cervix or urethra, and forty-seven cases of benign hemorrhage of myomatous or myopathic origin. The majority of cases received from 85 to 110 mg. of radium for twenty-four hours. In one case of cauliflower growth, in a woman of 28, who was six months pregnant, 210 mg. were applied with complete cure. The only immediate effects were nausea and vomiting, which usually ceased from twenty-four to thirty-six hours after removal of the radium. In 44 per cent. of cases of cancer there was complete healing, and in only two cases was there no benefit. In not a single instance has there been a failure to check bleeding in the case of benign hemorrhage. Mild symptoms of menopause were developed in ten cases. In cancer of the fundus, operation is preferable to radium; this is also true of early cervical cancer. In cases of small myoma, when the only symptom is hemorrhage, 100 per cent. of cures may be expected. This work is still on probation.

MORIARTA, DOUGLAS C. Radium a Palliative. (*Jour. Am. Med. Assn.*, Oct. 28, 1916, Vol. LXVII, p. 1325.) (Read at 29th Annual Meeting of Am. Association of Obstetricians and Gynecologists at Indianapolis, Sept., 1916.)

Radium overcomes the disagreeable odor which accompanies the breaking down of cancerous tissue. Further, it controls hemorrhage. In six cases in which Moriarta used radium, pain was relieved, the odor was remarkably controlled, hemorrhage ceased, and there was a change in or a disappearance of the local pathologic tissues. Two patients died in coma two months after the treatment; four are alive and hopeful. In one case the uterine hemorrhage was not of cancerous origin, but the condition was a terminal one. The author is sure the patient would have died had it not been for the use of radium. In using radium it is possible to produce a toxemia which may prove fatal, and the end has undoubtedly been hastened in this way. Two precautions are suggested when applying radium locally: first, a patient with a low leukocyte count should not be given prolonged applications; and second, it should be accompanied by the liberal administration of alkalies. No case of this type is so desperate, and no post-operative condition so hopeless, but radium should not be used with an expectation of alleviating the distressing symptoms.

JACOBSON, J. H. AND MURPHY, JOHN T. The Mechanics of the Stomach after Gastro-enterostomy. (*Jour. Am. Med. Assn.*, Oct. 28, 1916, Vol. LXVII, p. 1325.) (Read at 29th Annual Meeting of American Assn. of Obstetricians and Gynecologists at Indianapolis, Sept., 1916.)

All patients examined in this series were well. Gastro-enterostomy openings properly made and placed do not obliterate, and functionate equally well in the presence of either an open or closed pylorus. To secure the maximum amount of drainage, the opening must be of ample size and placed as near the pylorus as possible, preferably in the antrum pylori. Such openings must not be made on the fundus of the stomach or on the lesser curvature. Gastro-enterostomy is essentially a drainage operation. Serious distention in the jejunum does not occur. The food is seen to pass rapidly through the many loops of the small intestine before it stops. Even in those patients who are entirely relieved of their former symptoms, food can be forced backward into the stomach from the jejunum, and although this can be done easily, such regurgitations do not seem to make any difference.

KENNEDY, T. C. Radium Therapy. (*Jour. Am. Med. Assn.*, Oct. 28, 1916, Vol. LXVII, p. 1327.) (Read at Annual Meeting of Ind. State Med. Assn., Fort Wayne, Ind., Sept., 1916.)

The great value of radium in cancer can be judged only by keeping constantly in mind the fact that only the hopelessly inoperable, or patients with post-operative recurrences are

sent for radium therapy. If we relieve a small percentage and occasionally cure a patient who has been operated on or been refused operation on account of the seriousness of the condition, we have done much for suffering humanity.

In the discussion, Dr. M. I. Rosenthal declared radium to be a most valuable adjunct to surgery in the treatment of malignant growths, fibroids, and many other conditions. A woman with cancer of the uterus was operated on by the radical method, made a beautiful recovery and remained well for four years, then returned with a recurrence in the scar—a rare occurrence. We used radium, and after the ordinary treatment this carcinomatous condition has evidently disappeared. In cases such as this, radium is the only treatment; it is the last resort.

SEYMOUR, MALCOLM. The Treatment of Graves' Disease by the Roentgen Ray. (*Boston Med. and Surg. Jour.*, Oct. 19, 1916, Vol. CLXXV, p. 568.)

Although the treatment of Graves' disease by the roentgen ray has been used for many years, uniform results have not been obtained until recently. This lack of uniformity has been due to the inaccuracy in dosage, resulting in either no action or in serious burns, so that the treatment has been unsatisfactory and often dangerous.

The action of the roentgen ray on some of the ductless glands of the body has been observed for a long time. Its effect on the testicle and ovary is now common knowledge among the profession. Its atrophic action on the thyroid, thymus and pineal has recently received considerable study. The literature abounds in cases which have been successfully treated with the roentgen ray. In general, it was found that the longer the duration of the symptoms, the more treatment was required to cause abatement and disappearance. The reports of various careful observers indicate that there is little foundation in fact for the claim that the rays caused such changes in the capsules of the glands that made operation difficult.

Seymour writes of 144 cases of Graves' disease under treatment in the Massachusetts General Hospital since August 1, 1915. Of these 144 cases, 80 have been given at least two treatments. The average number of treatments received has been four. The duration of the treatments has been from two to eight months, the average being three and one-half months.

Of the 80 cases which have been treated, all have shown improvement with the exception of seven. Of these seven cases, three have received two treatments, three have received three treatments, and one has received four treatments. Five cases showed no change. Of the 80 cases, 8 were absolutely cured of their symptoms. Nearly all have gained in weight. The average gain has been seven pounds, one case having gained twenty-five pounds. The pulse rate has been lowered in all but a few cases, the average being twelve beats. The greatest lowering in pulse rate was 52 beats, from 146 to 94.

The method of treatment has been as follows: The neck has been divided into three areas,—right, left and middle or suprasternal. The average dosage has amounted to about 4 H, which equals 5 Holzknecht or 10 x Kienboeck or 1 B Sabouraud-Noire. The author very properly urges that the dosage be kept below the erythema dose so as not to cause any skin irritation.

In all cases the target of the tube was at a distance of 10 inches from the skin, and a filter of 4 mm of aluminum and one thickness of sole leather was interposed. Treatments were given at intervals of three or four weeks. Most of the patients have not changed their modes of living, excepting the diet, which has been arranged to help the anemia.

In the series of 144 cases various bony abnormalities were encountered. Five cases of cervical ribs were observed among the 144 cases studied, four being found during the physical examination, and one by the *x*-ray. All were without symptoms which might have been caused by this abnormality.

In closing the author says that the *x*-ray treatment of Graves' disease should not be undertaken except by those thoroughly experienced in roentgenotherapy.

MORGAN, H. J. Congenital Dextrocardia with Patent Ductus Ovale. (*Am. Jour. Dis. Child.*, Sept., 1916, Vol. XII, p. 233.)

Congenital dextrocardia alone is a rare condition. It is of still greater interest in the case reported because of the congenital defect of

the heart itself. In almost all reported cases there is a congenital defect of the heart.

Morgan's patient was a female baby upon whom an opportunity for a necropsy was afforded at nine months. At necropsy the left lobe of the thymus was found to be quite large, the tip being in the fourth interspace, the extreme left edge being 2½ cm to the left of the midsternal line. The heart was on the right side. The heart valves were normal except for the patent ductus ovale. The liver was on the normal side, as were all the other viscera.

PAUTRIER, L. M. Histogenesis of the Successful Treatment of Mycosis fungoides with Roentgen Rays. (*Strahlentherapie*, 1915, Vol. 6, No. 14. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 166.)

The histological examination of a mycotic tumor eight days after roentgen treatment (7=8 H at 5 Benoist) showed that the dense and compact infiltrate had completely broken down and disappeared. As to the roentgen therapy, Pautrier states that the above dosage is sufficient for tumors, while 3=5 H will suffice for erythematous and infiltrated skin areas. It is an important and novel observation that the skin of a mycotic patient is highly unsusceptible to roentgen rays. One thousand H may be applied to the entire skin surface without affecting the general condition in the slightest degree and without producing the least radiodermatitis. It is not stated, however, whether this experience is based upon this solitary instance or upon a number of cases. At any rate, the news requires corroboration.

FASSETT, F. J. A Method for Marking Roentgenograms. (*Am. Jour. Orthop. Surg.*, January, 1917, Vol. XV, p. 60.)

For several months the author has been using a method of marking plates which has at least the merit of simplicity of application. When the plate is in the envelopes, just before exposure, he writes on the smooth side of the yellow envelope the name of the patient, the date, "right" or "left" or other useful memoranda, and finally signs his name. In this writing he uses not a pen or pencil, but any small round-pointed instrument which lies at hand, sufficiently sharp to give a rather slender line and sufficiently dull to avoid danger of tearing the envelope. Unless the exposure of the plate so marked is very heavy, the lettering thus applied will show on the developed plate with sufficient clearness to avoid any possible confusion of this plate with others. It is necessary to write with more than ordinary pressure, as it is the pressure that makes the essential change in the emulsion of the plate.

SCHMIDT, H. E. The Employment of Hard, Filtered Rays in Dermatotherapy. (*Berl. kl. Wochnschr.*, 1916, No. 3. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 166.)

In opposition to F. M. Meyer, the author objects to the employment of hard, filtered roentgen rays in the superficial treatment of skin diseases. In his opinion their use means a step backward instead of forward. The use of the hardest possible filtered roentgen rays in skin affections is exclusively indicated in cases where a certain deep effect is necessary, and this depends on physical reasons only.

GAARENSTROOM, G. F. (Amsterdam, Holland). Sarcoma and Roentgen Rays. (*Arch. Radiol. and Electrother.*, Vol. XXI, No. 7, Dec., 1916, p. 220.)

From this report it will be gathered that during the last two years (1914 and 1915), twenty-three cases of sarcoma and closely related diseases have been treated roentgenologically at the Dutch Cancer Institute of Amsterdam. These are divided as to the seats of the affection as follows: 6 sarcomas originating from the lymphatic tissue; 5 sarcomas originating from the bone; 3 cases of lymphogranuloma; 2 melanosarcomas of the skin; 2 cases of pseudoleukemia; 1 case each of sarcoma of the eye, dura mater, testicle, posterior abdominal wall and cavum tympani.

All of the treatments were given in conformity with the rules of modern deep-ray therapy. Hard tubes and aluminum filters were used, also when open wounds were rayed after operation. When applying the rays to parts underneath the sound skin, it was found that 3 mm aluminum and a piece of leather of equal thickness formed an insufficient filter, as 15 to 18 H caused burns. Increasing the aluminum to 5 mm and the leather cover accordingly, a very satisfactory protection was achieved, especially as it permitted the application of doses

as large as 20 H with impunity. Women received smaller doses than men, and for children the dose was reduced to about three-quarters. Open wounds were rayed as soon as possible after the operation and repeated the next day until the required dose was reached.

Multiple entrances were also availed of, the details varying with the location. Thus, in treating the pharyngonasal cavity with hard rays, it was measured that about one-tenth part of the surface dose would reach the place of destination, and when carefully directing the bundle of rays through each of ten sections of skin prepared for the purpose, the dose arriving at the cavity would be just about equal to the largest admissible surface dose. In this way about 20 H could be administered to the tumor. If necessary, the radiation of the pharyngonasal cavity may be effected through the open mouth by using a speculum. In some cases, where the rays were applied through the eyes and the latter were not yet affected by the disease, only a passing conjunctivitis of a slight character was noticeable.

A description of some of the more interesting cases follows and, in reviewing the results, the author comments on the frequently expressed opinion that the rapidity of growth of the tumor is supposed to be an important factor and that, according to Kienboeck, sarcomas which develop quickly and recur soon after the operation, will mostly show a favorable reaction on being exposed to the roentgen rays. By way of contrast the author shows from his own series of cases that this doctrine is not always reliable and should not be implicitly accepted. The sarcomas of the fibula, femur and upper jaw, while showing rapid growth, did not react favorably in the least, whereas a very slowly developing angiosarcoma of the tympanic cavity showed prompt reaction to the roentgen rays and soon became smaller.

Furthermore, the author complains that most other writers seem to be convinced that neither the clinical factors nor an examination of the histological structure can determine beforehand whether a tumor will react favorably or not. To support his opposite standpoint, the author reviews his cases as follows:

Round cellular sarcoma, 12 cases, all of whom have shown favorable reaction. Part of these are now entirely without visible symptoms, and the remaining patients showed local cure or improvement but died from general metastasis.

Spindle cell sarcoma, 3 cases, two of which have shown favorable reaction.

Sarcoma with polymorphous cells, 4 cases, none of which have shown the least favorable reaction.

It is evident, therefore, that round-cell sarcoma generally reacts favorably, the spindle-cell variety only in some cases, while sarcoma with polymorphous cells does not react at all. This, however, is not an absolutely hard and fast rule, as in the literature cases are mentioned in which sarcomas with polymorphous cells have reacted favorably. As to melanosarcomas, opinions differ, which must be attributed to the fact that, although they have one factor in common (pigmentation), they can not all be considered alike. Some have big, round cells of alveolar structure, others have spindle cells or polymorphous cells, and the cases described by the author prove that sarcomas with polymorphous cells react badly, while those with spindle cells or round cells react more favorably. Altogether the author wishes to go on record as stating that in his opinion the best criterion at the present time for determining the sensitiveness of sarcomas to the influence of roentgen rays is the histological structure of the tumor.

McCleave, T. T. A Case of Diaphragmatic Hernia. (*Am. Jour. Dis. of Children*, March, 1917, p. 252.)

The report of the present case is an interesting and commendable contribution to the literature. It assigns an important place to the life-saving rôle a roentgen examination may play in a progressive and dangerous condition, and has the merit of giving a reasonable degree of detail with the aid of eight excellent roentgenograms which pressure on our space alone prevents us from reproducing.

The patient was a baby, 3½ months old, practically moribund and suffering from cyanosis, dyspnea and severe pain. The clinical diagnosis was probable diaphragmatic hernia which was confirmed by a series of roentgenograms. The latter disclosed the fact, in the first place, that the heart was displaced far over to the right side and that the left side of the thorax was filled with gas. A roentgenogram taken after a barium enema showed the colon well within the chest cavity, and one taken fifteen minutes after a barium meal

showed almost all of the intestine above the diaphragm. A further series of exposures taken at from one to eight hours after the barium meal further confirmed the diagnosis.

At operation the defect in the diaphragm was found to be an oblique slit, through which the intestine was replaced, followed by suture. Considering the moribund condition of the patient and the shock of the operation, it was not surprising that the latter was not survived by more than a few hours.

A physician who had previously attended the little patient declared that he had not then noticed the cardiac displacement and absence of breath sounds, and believed that these signs developed later. The history of gradual increase with exaggeration of symptoms would also indicate that the herniation of the bowel into the thorax had been progressive. If at the time of the operation there had been but little intestine to handle, as would have been the case at an earlier stage, there would, in the author's judgment, have been reasonable expectation of recovery.

This case, therefore, shows that a history of dyspnea and cyanosis, otherwise unaccounted for, especially if relieved by the passage of gas and feces, should excite suspicion of diaphragmatic hernia and a roentgenological examination should be promptly resorted to, since the latter affords a ready and definite means of diagnosis. The case also demonstrates the fact that the degree of herniation of the bowel is no criterion of the extent of the defect in the diaphragm and would seem to suggest the propriety of early operation.

ABBE, ROBERT. The Place of Radium in the Treatment of Cancer. (*Med. Rec.*, Vol. 91, No. 22, June 2, 1917, p. 931.)

The instances singled out by Abbe as illustrating the effect of radium treatment go to show that a definite place for radium has not yet been established in the treatment of cancer. He concludes: "Cancer of the stomach, rectum and uterus invite the surgeon to constant battle by reason of the pitifulness of ordinary surgical results. There is no question of the retarding effects of radium on many cases of rectal and uterine cancer. To speak of cure at this date, is not possible in this class of cases — the inoperable cancer. Nevertheless, occasional cases of early epithelioma of the cervix have remained cured and recurrences have melted away for a couple of years, only to return later to challenge the undiscouraged surgeon.

"The line of battle has extended so far in all fields of surgical endeavor that radium has now justified its claim as a unique agent in the hands of surgeons in combating many phases of this disease. The efficiency of the subtle power of radium is a surprise only to those who have not studied it in thousands of experiments in the laboratory, the garden, the animal life, from the embryonic sea urchin, the ant, the fly, guinea-pig and rabbit, up to man. Another decade, and another still, will yet see the knowledge of its value incomplete."

NECESSITY FOR ROENTGEN EXAMINATION. (*Med. Rec.*, Vol. 91, No. 22, June 2, 1917, p. 945.)

In an action against a railway company for damages for an injury to the motor nerve, causing the loss of the right leg, the defendant urges, on appeal, that the refusal of the circuit judge to force the plaintiff to submit to a roentgen examination was reversible error. As to this the court said: "The testimony of the physicians in this case does not disclose the fact that a roentgen examination would determine the extent of the injury. Dr. Kelly was of the opinion that no relief could come except from a very delicate, dangerous operation; one that he would not advise a brother to submit to. Dr. Ellis Weaver said the nerve could not be seen by the use of an *x*-ray. Both believed the injury permanent. Under this state of case, the circuit judge did not abuse his discretion in overruling the motion for an *x*-ray examination. This court will not interfere with matters within the discretion of the lower court, unless there is a clear abuse of the power." Louisiana & A. Ry. Co. vs. Woodson, Arkansas Supreme Court, 192 S. W. 174.

HAUDECK, MARTIN. The Callus Gap; Its Forms and Significance in the Healing Process of Chronic Ulcerations of the Bones. (*Muench. med. Wchnschr.*, 1916, No. 15. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 158.)

Operative measures often interfere considerably with the final healing of suppurating bone fistulæ, following complicated shot injuries. The fistular duct is a very unreliable guide for the knife. Starting from the healthy end, it is often difficult on account of the very callus formation to find the cavity or sequester from which the suppuration emanates. With the aid of the roentgen method, however, it is possible to single out a certain type from this large group of injuries which offers unusually favorable conditions for the surgical indications. This is what Haudeck calls the callus gap, the most important property of which is a sharply delineated gap at a certain place in the dense and thick callus, that place being at the exit of the bone cavity harboring the sequesters. This callus gap may be compared with an unclean ulcer which is irritated again and again by inflammatory processes. It also serves as a door for the pus to flow off. Sequestration is not an absolute condition, the callus gap being pathognomonic even without such.

The roentgenological demonstration of the callus gap simplifies the operative procedure enormously, the bone in all such cases being sufficiently consolidated to suffer an operation. The way to the pathological focus, which need not follow the fistular opening, is plainly shown, and the callus need not be interfered with at all. The technic is very simple. Two exposures should be made at right angles to each other. It is necessary either to introduce a sound or to inject some bismuth paste.

SIEGERT, F. Diagnosis and Therapy of Latent Thymus Hyperplasia in Early Childhood. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 159.)

Roentgenoscopy will remove any doubt in the diagnosis of latent thymus hyperplasia in early childhood, especially in the differential diagnosis with tuberculous paratracheal glands. Siegert found that the thymus shadow, especially when distant instantaneous exposures are made, cover exactly the thymus dullness. Furthermore, an instantaneous exposure permits not only of an approximate judgment but also of perfect control of the successful treatment after operation or in radiolysis. The eccentric hypertrophy of the heart which is of frequent occurrence in the adult, but is not especially noticed in early childhood, is easily demonstrable by roentgenoscopy. Siegert found without exception an enlarged shadow in nurslings, especially also on the right side, contrary to the findings in adults.

The author thinks it strange that this phenomenon has not yet been mentioned in the literature. He inclines to consider it a regular occurrence even in absolutely latent thymus hyperplasia.

FINZI, N. S. Pharyngeal Pouches. (Royal Society of Med., Sec. of Electrotherapeutics, Dec. 15, 1916. Ref. *Lancet*, London, Dec. 30, 1916, Vol. CXCI, p. 1103.)

Finzi first discussed the situation and origins of such pouches. Usually, by the time the roentgenographer saw a pharyngeal pouch it had reached an advanced stage, sometimes so advanced that it obstructed the esophagus by pressing upon the contents. His present purpose was to treat the subject of diagnosis from the *x*-ray appearances. He found that the best substance to give the patient to eat with the object of facilitating the roentgenographic representation was a semisolid paste of bismuth oxychloride. The consistency should be such that it does not flow back immediately to its natural level. Such a paste was found to adhere to the pharynx for an appreciable time. He regarded as very important the examination of cases of suspected pouch by the fluorescent screen; otherwise much difficulty was experienced in differentiating them from malignant strictures. The diagnostic feature to watch for was the way in which the bismuth that had been given left the pouch. If the conditions were a pharyngeal pouch, the bismuth could be seen leaving the mouth of the pouch and passing thence straight into the esophagus. Sometimes it was exuded in that way by the contraction of the muscles of the throat. In the conditions with which such pouches were liable to be confused—i.e., carcinomatous or fibrous strictures—the bismuth was arrested, and later it could be seen leaving the center or the lower end of the dilated esophagus. He showed a number of roentgenograms to illustrate the points.

Sometimes a pouch became inflamed, and an indentation formed at the lower end in consequence of adhesions having occurred. One case in which the diagnosis was very obscure was that of a very old and weak patient in whom some of the bismuth given passed into the trachea and into one bronchus. It was natural to suppose there was a growth, which was causing complete obstruction, and that some part of the bismuth was escaping through a sinus into the trachea. It proved, however, to be a pouch. He found that a true lateral view gave a far better idea of the condition in these pouch cases than did any other. In the case of a very large pouch it was well to place the *x*-ray tube some distance off, so as to have parallel rays impinging, and to correct distortion. If the pouch were somewhat low, and the patient a tractable one, he should be bidden to commence to swallow and try to retain the larynx in that higher position for a brief space. One patient with a large pouch had been operated upon three years previously by gastro-enterostomy because he was supposed to have carcinoma. Had he been examined with the esophagoscope the mistake could scarcely have been made. When the pouch had been discovered it was removed. After viewing these cases with the screen his practice was to take a plate also, as the details in the latter assisted in the diagnosis. His patients were always examined in the standing position. He did not think spasmodic stricture came into the diagnostic problem, because it was unlikely to occur in this situation. Fortunately, a fibrous stricture was rare in this region, as its diagnosis from a pouch might be very difficult. Pharyngeal pouches were supposed to be very rare, but the eight cases, pictures of which he had shown, occurred in his private practice in the course of five and a half years. Usually the presence of these pouches was not suspected until they became large enough to cause symptoms.

BLUMENTHAL, FRANZ AND KARSIS, J. The Biological Effect of Roentgen Rays on Mice. (*Deutsche med. Wchnschr.*, Sept. 28, 1916, Vol. 42, No. 39, p. 1185.)

The authors have reviewed the history of the experimental work which has been done relating to the therapeutic effect of radium and roentgen rays on living cells. They also carried out experiments applying roentgen rays to white mice and guinea pigs, changing the dosage, the filters and the hardness of the tubes. They worked not only with rays of different degrees of hardness but also of different ray spectra.

Their investigations have shown that hard roentgen rays, such as are now applied in deep therapy, will cause in mice, even in relatively small doses, such an enormous injury to the organism that death ensues in a short time. Even unfiltered rays of a high degree of hardness have a more destructive effect upon the organism of mice than rays of a lower degree of hardness. Furthermore, when different ray spectra of the same hardness are used, the effect of the spectrum containing the largest quantity of hard rays exerts the greatest effect. If a spectrum of the identical tube is hardened by filters of varying thicknesses, the injurious effect of the rays is increased in proportion to the hardening of the rays, and if the hardening exceeds a certain limit, the effect of the roentgen rays is not increased, but, on the contrary, there is a decrease in effect upon the organism of mice. This is explained by the assumption that the rays have become so penetrating that only a small portion of them can be absorbed and thus becomes effective in the organism of mice. The dosage which is sufficient to kill mice within a short time is sometimes smaller than that applied at a single deep roentgen treatment of human patients. But it is obviously impossible to draw a parallel between these two contingencies. The mere fact that in the case of mice the entire organism is exposed at once to the baneful influence of the rays, whereas in the therapeutic exposure of areas or fields only small parts of the human body are so exposed, changes the entire aspect of affairs.

Another point is the fact that the greater portion of the rays, even with powerful filters and the hardest tubes, is absorbed in the upper strata, whereas in mice they immediately reach the vital organs. But even so, the endeavor to obtain harder and ever harder ray spectra must finally culminate in reaching a point where greater caution will be demanded in the application of the rays to the human being. Even at the present time, general toxic manifestations are observed in patients who have been exposed to large doses, especially in deep ray therapy; and the fact that cachexia has been frequently observed after roentgen treatment may to a certain extent be attributable to an injurious effect of the rays.

BOOK REVIEWS

THE ROENTGEN DIAGNOSIS OF DISEASES OF THE ALIMENTARY CANAL. By RUSSELL D. CARMAN, M.D., Head of Section on Roentgenology, Division of Medicine, Mayo Clinic and ALBERT MILLER, M.D., First Assistant in Roentgenology at the Mayo Clinic. Octavo of 558 pages with 504 original illustrations. Philadelphia and London: W. B. Saunders Company, 1917. Cloth $6.00 net; Half Morocco, $7.50 net.

The present publication is one which not only fills a distinct want in the roentgenological literature but fills it to the satisfaction of the most exacting. The unusual facilities the authors enjoyed in the service of the Mayo Clinic for observation and study of a multitude and great variety of cases, together with the facilities for recording their observations for purposes of publication, form an excellent foundation on which to build a work of this importance; and the personal efficiency and experience of the authors did the rest to produce a book which for purposes of reference and practical application may be considered a standard for both the experienced roentgenologist and the student.

It is true, most of the subjects have been dealt with in the roentgenological literature, but they are widely scattered not only in the English but principally also in the various foreign publications, and while it is impossible for the average practitioner to keep track of all these publications, it is a task of no mean magnitude to discriminate between the good, bad and indifferent in this multitude of scattered information.

The AMERICAN JOURNAL OF ROENTGENOLOGY, fully appreciating the importance of this matter, established its department for Abstracts and Translations, through which the reader is kept abreast of all the best technical communications contained in the press of this and other lands. Carman and Miller have performed the same task in the present publication, and while the information thus communicated necessarily stops with the date of publication, it has the advantage of being accompanied by the authors' personal experience on every one of the important subjects treated. They have not even flinched from communicating errors they have made in full appreciation of the value of prevention of similar errors in the future.

The authors do not claim that their opinion on all the subjects discussed is infallible or final. Roentgenology has not by any means arrived at anything like a stage of finality, and possibly never will. In the meantime, contradictory opinions of experts should be chronicled and sifted, so that future study, experience, observations and discoveries may ultimately settle controversial points. This is another task to which the book lends valuable aid.

In the first chapter the authors deal with the roentgenological apparatus as have proved best in their experience in the diagnosis of diseases of the alimentary tract from esophagus to rectum, and this is followed in the second chapter by the technic employed. A special chapter is devoted to the interpretation of the plates, and too much attention can not be given to the words of wisdom which will help to make the diagnosis a success and safeguard against failure and mistakes.

The following chapters deal seriatim with the esophagus, the stomach and its normal and abnormal condition, including spasm, cancer, fibromatosis, syphilis, ulcer and other affections of the stomach. The stomach of infants and children occupies a chapter by itself.

Gallstones and diseases of the bladder and liver are dealt with in another chapter. Next follow the small intestine, duodenal ulcer, the large intestine, cancer of the colon, diverticulitis, tuberculosis of the colon and chronic colitis.

The vexed question of intestinal stasis has also been specially considered. After giving a short summary of Lane's theory of kinks and bands as demanding surgical interference, the authors proceed to analyze the prevailing views, quoting a number of authors both for and against the arguments advanced. So far as their own activities go, the authors state that those of their patients who were operated on for intestinal stasis were explored not solely because of the roentgen findings but because the clinical factors justified surgical intervention. Often there was a history of a previous operation. In some cases this had been done for the relief of stasis, but without success. In view of their own indecisive experience and the

varying experience of others with the roentgen examination for stasis, they feel that any general conclusions on their part can only be offered with diffidence. They believe, however, that the greatest value of the roentgen rays consists not in showing organic obstruction but in excluding it, and that at present clinical considerations must largely determine both diagnosis and treatment.

The chapter on appendicitis is of interest for the record of both positive and negative results. Thus, spasticity of the distal colon in cases which at operation proved to be chronic appendicitis, was noted sufficiently often to occasion remark, but while interesting, this could not be considered diagnostic. In a small percentage of the colons examined the appendix was visualized by the enema. Some of these cases went to operation and a chronic appendicitis was found. In two instances the appendix contained fecaliths, but the roentgenograms did not show their presence. In scores of patients operated on for chronic appendicitis the roentgen examination of the colon was negative.

The book is profusely illustrated with a large number of excellent roentgenograms and also reproduces specimens of charts for recording fluoroscopic examinations. Plentiful bibliographic references facilitate further study of any of the points involved. The library of any practitioner or student of roentgenology would be incomplete without Carman and Miller's book on its shelves not only on account of the wealth of information it contains but also for the impartial spirit with which their own observations as well as those of others have been recorded.

SURGICAL CLINICS OF CHICAGO. Vol. I, No. 2, April, 1917. With 99 illustrations. 448 pages. Published bi-monthly. Price per year: Paper $10.00; Cloth $14.00. W. B. Saunders Company, Publishers, Philadelphia.

Every ambitious roentgenologist will endeavor to maintain a maximum degree of familiarity with the current medical and surgical literature with special reference to the new developments. The *Surgical Clinics of Chicago* are an easy means for keeping up with modern surgery, although here and there lapses occur which are somewhat difficult to forgive. When one considers that these *Clinics* represent the expression of opinions of individuals, and not set views on the topics considered, these lapses are more easily overlooked.

In the first clinic of the present issue, Dr. A. J. Ochsner, of the Augustana Hospital, considers "Carcinoma of the Breast." His technic of postoperative roentgen treatment, which he describes, is one that does not appeal to the reviewer. He describes the intense roentgen treatment given every day for four days until six intense treatments have been given, but detail is lacking whether the treatments are given on each day over a different area or whether the entire surface is covered each time for six consecutive treatments with four days' intervals.

Favorable comment has been made upon the author's statement that the application of roentgen rays interferes with the growth of skin grafts: this we have found to be true.

Otherwise the reviewer has nothing but praise for the remainder of Dr. Ochsner's Clinic.

Surgical Lesions of the Colon are considered by Arthur Dean Bevan with the usual presentation of the clinical evidence; roentgenological findings are referred to in the diagnostic considerations to an almost negligible degree. On this as well as on other occasions the impression can only with difficulty be resisted that the profession of Chicago does not appreciate the achievements and advantages of the roentgen rays which to other sections of the community have been a boon and blessing for a considerable time past.

A description of previously operated cases of tuberculosis of the first phalanx of the middle finger, arthroplasty for ankylosis of elbow, double dislocation of the shoulder, fracture of the humerus (bone transplant) and congenital absence of scaphoid (repair by bone transplantation) contains a profuse and satisfactory assortment of roentgenographic illustrations.